NEW SERIES, VOL. XLI SEPTEMBER, 1938 No. 3

The American Journal of Surgery

is the leading independent surgical Journal. It publishes many papers read before the outstanding Surgical Societies, but it is *not* "the official organ" of any organization.

Copyright, 1938, by The American Journal of Surgery, Inc.

EDITORIAL BOARD

Editor:

Thurston Scott Welton

New York

D. C. Balfour *Rochester, Minn.*
Carl Beck *Chicago*
George R. Brighton *New York*
Meredith F. Campbell *New York*
James T. Case *Chicago*
Isidore Cohn *New Orleans*
Bradley L. Coley *New York*
F. A. Coller *Ann Arbor*
George W. Crile *Cleveland*
E. C. Cutler *Boston*
R. V. Day *Los Angeles*
Charles A. Elsberg *New York*
Herbert C. Fett *Brooklyn*
C. R. G. Forrester *Chicago*
H. Dawson Furniss *New York*
J. H. Gibbon *Philadelphia*
Emil Goetsch *Brooklyn*
Charles A. Gordon *Brooklyn*
Donald Guthrie *Sayre, Pa.*
A. E. Hertzler *Kansas City*
Louis J. Hirschman *Detroit*
James M. Hitzrot *New York*
Frederick C. Holden *New York*
Emile F. Holman *San Francisco*
J. A. Hyams *New York*
R. H. Jackson *Madison*
John E. Jennings *Brooklyn*
W. L. Keller *Washington, D.C.*
H. A. Kelly *Baltimore*
T. J. Kirwin *New York*
Arthur Krida *New York*
A. V. S. Lambert *New York*
Maurice Lenz *New York*
H. H. M. Lyle *New York*
Jerome M. Lynch *New York*
Urban Maes *New Orleans*
Harrison S. Martland *Newark*
Rudolph Matas *New Orleans*
Roy D. McClure *Detroit*
H. C. Naffziger *San Francisco*
C. R. O'Crowley *Newark*
Louis E. Phaneuf *Boston*
Eugene H. Pool *New York*
Douglas Quick *New York*
N. P. Rathbun *Brooklyn*
H. A. Royster *Raleigh*
Henry S. Ruth *Philadelphia*
A. C. Scott *Temple*
M. G. Seelig *St. Louis*
J. Bentley Squier *New York*
H. J. Stander *New York*
George W. Swift *Seattle*
H. L. Updegraff *Los Angeles*
Grant E. Ward *Baltimore*
J. H. Woolsey *San Francisco*

EDITORIALS

THE SURGICAL STAFF AND THE MANAGEMENT OF SPREADING PERITONITIS COMPLICATING ACUTE PERFORATIVE APPENDICITIS

OF the acute pathologic processes in man in which surgery is indicated, there is none that requires the nicety of judgment for its successful management equal to spreading peritonitis complicating acute perforative appendicitis. Many surgeons have become proficient in managing these cases, but the wisdom necessary has come after many failures and years of experience.

Conservatism usually accompanies advanced years. 'Go-get-ism' has been gradually replaced by a calm, deliberate attempt to estimate the chances of success of a given plan of procedure and to compare this with other methods. The surgical chief in the average hospital is usually a man of this type and associated with him are enthusiastic seekers for facts, on the way up in surgery.

Duties of the Chief of the Surgical Service. The mortality of spreading peritonitis in the average hospital is largely dependent upon the thoroughness and care exercised by the chief in a constant check-up of his service and the allotment of specific duties to each member of his staff. The successful management of spreading peritonitis is not a one-man job—it is a job for the entire surgical group. The chief of service should see all cases. This is not as large an assignment as it appears to be; of every 100 cases admitted to our general hospitals with a diagnosis of acute appendicitis, fourteen have a spreading peritonitis; 40 per cent of these are admitted between 7 A.M. and 7 P.M.; 60 per cent from 7 P.M. to 7 A.M. A service of 100 cases a year would therefore necessitate his being called at night only eight times.

The chief usually manages the difficult cases of gall-bladder disease, common duct stones, the case with unusual gastric pathology. Is there any reason why he should not at least supervise the management of spreading peritonitis which has a mortality as high and in some instances higher, than these conditions? If the operative mortality is to be reduced, such a plan must be adopted. The surgeon-in-chief must consult with his associates in these cases and the younger man on the service must not be permitted to manage them without supervision. This consultation before operation is a service that should be given every patient suspected of having a spreading peritonitis. Proper management of an acute process which shows a mortality of from 25 to 40 per cent demands it.

A correct diagnosis is at times extremely difficult to make, as every experienced surgeon knows. It is not the diagnosis of an acute appendicitis or a frank spreading peritonitis which offers difficulty. Either of these is usually recognized by the physician who sends the patient into the hospital and the intern on service. It is the diagnosis of the perforation associated with symptoms and signs of a spreading peritonitis of moderate degree, which goes unrecognized not only by the family physician and the intern but also by the associates and even the chief as well, that merits special study. I am not discussing the exceptional diagnostician—we must keep in mind the average; and I am thinking of my own service where only 75 per cent of perforations admitted with a moderate degree of spreading peritonitis were diagnosed definitely before operation.

For the good of the service, the chief must be willing to commit himself in writing on the clinical record, regarding the results of his preoperative examination. Whether he delegates the operation to his associates or does it himself, his opinion is on record; and if he is human, he prides himself on his opinion, verbal expressions of which do not have the habit of confronting him with their irrevocability. Suppose the chief is wrong. A great part of the foundation of the successful management of surgical cases by an associate is built on the mistakes, not the successes, of his chief.

Duties of the Associate Surgeon. The associate surgeon should operate on the simple cases of appendicitis and on those that have definitely localized. He should always consult his chief about the management of patients with suspected early perforations or frank spreading peritonitis. He should concentrate on diagnosis and postoperative management. There is a large field for improvement in both. There is a tendency for surgeons, as they approach maturity, to discard the stethoscope as unnecessary equipment. I suggest to the associate surgeon that he develop the 'stethoscope habit.' He will soon realize, after applying it frequently to the abdomen of patients suffering from an acute lesion, both before and after operation, that peristaltic sounds can be as significant and characteristic as are the râles the internist hears during the various stages of a pneumonic process.

It should also be the duty of the associate surgeon to check the glucose metabolic balance daily; to decide when fluids should first be given by mouth, as well as the quantity and frequency of administration; whether the intravenous drip or hypodermoclysis, one or both, should be discontinued when the fluids are given by mouth. He should decide when the first dressing is to be done, whether the drain is to be loosened, partially removed, removed completely or removed and replaced by another drain. The intern may think that the associate surgeon is appropriating his duties. Not so! The decisions made by the associate surgeon are of major significance; they may mean the prevention of complications which may prolong the patient's sojourn in the hospital, or at times cause his death.

Duties of the Surgical Intern. They will vary with the size of the service and the manner in which he discharges responsibilities placed upon him. He will soon

realize that there is more to the problem of successful management than surgical intervention; that operation at times plays a small part, sometimes a *very* small part, in the management of these cases; that so far as he or anyone associated with the management of the case is concerned, persistent endeavor is the essential. Are the restlessness, the mild delirium and the attempts to get out of bed, due to a developing uremia or to the absorption of toxic products from the wound or peritoneum? What is the significance of the unusual rise in temperature? Is it due to a spread of the inflammatory processes in the peritoneal cavity or is it only a wound infection? Why is there an increase in pulse rate? In what part of the abdomen will peristalsis first be heard and what significance may be attached to the delay? How does the fluid and glucose intake check up with the patient's actual need? How does the output of urine compare with the fluid given? Does the patient's circulatory response warrant a continued venoclysis of glucose or should he be given subcutaneous injections only? What conditions warrant the passage of a Levin tube? Does the nurse know what to do if the patient develops an anaphylactic reaction? Does she have the necessary drugs and equipment at hand? Finally, he should know that his obligation to a critically ill patient necessitates a carry-over of the watchful routine he has instituted. Before he leaves the hospital for his 'afternoon or evening off' he should visit the patient, with the relief intern, and talk over pertinent points relative to management. Both patient and relief intern will profit by this conference and the surgical intern will inaugurate a habit that will be of value to him in his subsequent duties as a physician or surgeon.

John O. Bower, M.D.

IN REGARD TO "RHYTHMIC SURGERY"

DRS. W. H. Lawrence and C. H. Berry's article in this issue, "Rhythmic Surgery," is the first of a series of papers on improvements of surgical technique and operating room management, based on studies of motion and efficiency. Rhythm represents measured and balanced movements, wherever found, whether in poetry, industry, music or sports. Since success in any field where manual movements are required is marked by rhythm, this element is an essential in the smooth performance of a surgical operation.

Motion study in industry has resulted in the rationalization of technique, the smoothing out of rough spots, in genuinely improved efficiency which has pointed out the 'one best way' of doing each step. It is well known that industry in general has undergone a revolution due to the adapta tion of motion study to the procedures of manufacturing; a similar revolution in distribution came with knowledge of systematization and the establishment of thorough and efficient routines. The surgeon, however, has maintained his right to follow his personal methods, to train his assistants in those methods, and to use whatever instruments, supplies, and techniques he found advisable. Few scientific studies have ever attempted to simplify the myriads of procedures, find their common denominator and evolve a 'best way' for the performance of each step.

Different operating room equipment, different set-ups, different instruments and supplies, different methods, different motions have been used by each operator. One may well doubt whether any one surgeon has found the 'one best way.' Although master surgeons may have achieved high degrees of perfection in their own work, it is doubtful whether the rank and file of men doing surgery have profited by the great variability. Certainly the hospital has found the system one of waste and inefficiency. Personally trained assistants,

though valuable to one surgeon, are valueless to others and must spend days or weeks in learning new methods and new techniques of coöperation. Operating set-ups, different for each surgeon, mean wasteful reduplication of instruments and repeated changes in the operating room. Ineffective arrangements of instruments mean a surplus of assistants and nurses. Such considerations as these make standardization a desirable change.

The authors intend to attack all these problems and others in their series. They have established certain principles of work simplification as a basis for their study, and in this first article take up the essentials of a proper working place and the arrangement of equipment to permit the use of principles of motion economy. A circular assembly set-up is described, with tables of normal grasping area, so situated that nurses may at all times face the operative field. Waste motions are eliminated; prelocation of instruments and the utilization of both hands make for speed; the organization of the table obviates error; and the avoidance of the necessity of turning away from the patient to secure any desired piece of apparatus or equipment ends breaks in aseptic technique from this cause.

In the future training of surgeons, such motion study can offer great aid—standardization in best methods will mean simplification of the learning period, readier assistance to the chief surgeon, and less bungling. For the patient, increased speed will mean shorter operations and surer technique. For the hospital, the simplification of instrument and supply tables, the greater uniformity in efficient operating room management, standardization of instrument set-up for operations will bring about increased efficiency in nursing personnel, a saving in instruments and the establishment of a simplified routine, minimizing risk and producing systematic procedures.

While we are on this subject, it might be well to discuss for a moment the operating room equipment of the average hospital. In our travels we have visited many hospitals and have seen far too many outmoded lights, out-of-date operating tables and sterilizers. We have seen surgeons throw clamps on the floor because they unlocked, often causing embarrassment. We have heard surgeons complain that scissors were dull and would not cut.

Operating room equipment should be up to the minute. In the long run, it pays to invest in quality—not to buy merely because the "price is right." From the standpoint of the finest work of the surgeon and the best welfare of the patient, genuine economy consists in providing modern equipment of high standard.

In this connection, the work of Dr. Lawrence and the Summit Medical Group may be the outset of a revolution in surgery. It is the beginning of group rather than individual advance in surgical technique. It means the development of new apparatus and new techniques. A fundamental rather than a minor change, this new streamlining of surgery is a step in the direction of basic reorganization.

T. S. W.

Subscribers to The American Journal of Surgery *visiting New York City are invited to make the office of the publishers (The American Journal of Surgery, Inc., 49 West 45th Street, New York) their headquarters. Mail, packages or bundles may be addressed in our care. Hotel reservations will gladly be made for those advising us in advance; kindly notify us in detail as to requirements and prices.*

ORIGINAL ARTICLES

SUPRAVAGINAL HYSTERECTOMY*

A REVIEW OF 535 CONSECUTIVE PERSONAL CASES

WALTER T. DANNREUTHER, M.D., F.A.C.S.

Professor of Gynecology, New York Post-Graduate Medical School

NEW YORK CITY

DISCUSSIONS of the virtues of total versus subtotal extirpation of the uterus, as well as of the relative merits of abdominal and vaginal hysterectomy, have provided material for endless debates without establishing a unanimity of opinion. The subtotal abdominal operation is sometimes the method of choice simply because of the facility with which it can be performed and the greater security of adjacent structures, which alone are poor reasons for its popularity. It would be futile to venture a recapitulation of the views of various gynecologists, or to expect that the indications for each type of operative procedure formulated by an individual pelvic surgeon will be accepted by others of equal experience. The uterus is neither a vital nor a superfluous organ; it can frequently be sacrificed to the patient's advantage, but all too often serves as the pretext for indiscriminate surgery by the occasional operator. Hysterectomy is the surest but not always the best way of curing uterine bleeding and discharge.

Personally, I reserve the vaginal route for elderly married women, in whom the cervix can be pulled down to the introitus without difficulty, and use it chiefly in cases in which the uterus is not greatly enlarged or is prolapsed. For women in the child-bearing age and those past the menopause whose sexual activities are an important factor in their domestic happiness, I prefer the abdominal operation. Furthermore, I am convinced of the desirability of conserving the cervix whenever possible, not because of any material difference in the morbidity and mortality of complete and supravaginal hysterectomy, as there is little difference in the hands of a skilful operator, but on account of the marital difficulties and dyspareunia which often follow cervical excision. That I am not otherwise prejudiced in this respect is attested by the fact that the 535 supravaginal hysterectomies herein reported were paralleled by 50 total hysterectomies with no mortality. The argument has been made that actual operative shortening can be avoided by removing the cervix close to the vaginal fornix, but if an inquiry is made of each patient subjected to complete hysterectomy, irrespective of who performed the operation, the almost invariable confession of subsequent sexual impairment or unpleasantness becomes a forcible argument in favor of cervical retention. Obviously, this argument becomes untenable in the presence of extensive cervical disease, malignancy, or potentially malignant lesions.

To summarize, I believe that it is a mistake to perform a single type of operation routinely; that vaginal hysterectomy, total abdominal hysterectomy, or the supravaginal operation should be

* From the Department of Gynecology, New York Post-Graduate Medical School and Hospital, Columbia University.

selected on the basis of definite indications in each individual case; and that the supravaginal operation, if myomectomy alone will not suffice, is preferable for the cure of benign conditions in sexually active women. In occasional cases it is possible to preserve a miniature menstruation. It will probably be conceded that supracervical hysterectomy is more widely practiced than either of the other methods, and some of the published end results reveal morbidity and mortality rates which seem unnecessarily high.

The chief purpose of this presentation is therefore not to try to convert the staunch advocates of either vaginal hysterectomy or the abdominal total operation to supravaginal hysterectomy, but to record the details of the preoperative preparation and operative technique in a series of 535 supracervical hysterectomies, with no pretense of originality, which have apparently reduced some of the hazards involved and eventuated in a comparatively low postoperative morbidity and mortality. A comprehensive discussion of the indications for the operation and the conservation or extirpation of ovaries, is not within the scope of this paper.

PRELIMINARY TREATMENT OF THE CERVIX

No one can dispute the fact that a diseased cervical stump remains a menace throughout the patient's subsequent life, either as a focus of infection or as a likely site for malignant transformations. Hence, if the cervix is to be left, the vaginal surface of the portio must be completely epithelialized and the endocervical canal free from infection and inflammatory products. On the other hand, lesions which are amenable to modern therapeutic methods do not justify ruthless extirpation. With ample time for preoperative attention, the majority of damaged cervices can be reconverted to a healthy state. For practical purposes, the condition of the cervix may be arbitrarily considered as follows:

1. The normal nulliparous cervix. This requires no further comment.

2. The cervix which has been slightly lacerated, but is well healed, and presents no erosion, ectropion, or deep infiltration of scar tissue. Such a stump can be safely ignored.

3. A more extensively lacerated cervix with a moderate degree of erosion or ectropion, but free from infection. This condition is easily corrected by simple, light cauterization.

4. A cervix which has not been deeply lacerated, but which is the seat of severe chronic endocervicitis. The endocervicitis can be eliminated by either conization with a high tension current, using the Hyams electrode, or by electrocoagulation with the Cherry bipolar electrode. Small coëxisting Nabothian cysts can be evacuated and sterilized with a fine wire cautery tip. Absolute eradication of pyogenic bacteria and cervical leucorrhea is the only criterion of safety in these cases.

5. A cervix which has been widely or irregularly lacerated, with deep infiltration of the cicatrix, large bulky Nabothian cysts, associated infection, and ectropion. This type of cervix should be removed with the uterine corpus.

6. A cervix which presents large eroded, ulcerated, or irregular areas in the region of the external os should invariably be subjected to biopsy. The specimens are best taken with a wire loop and the high tension cutting current. The plural is used advisedly, as I learned long ago that it is unwise to rely upon a solitary specimen; one should be taken from both the anterior and posterior cervical lips. The suspended decision pending the histologic examination then does not involve total and subtotal hysterectomy, but resolves itself into a choice between complete ablation of the uterus and irradiation.

To reiterate, a normal cervix or one that can be restored to a reasonably normal condition before operation may safely be left in situ. All others should be included in the hysterectomy. The chief point to be

emphasized is that many damaged cervices can be markedly improved by appropriate treatment. In the group of supravaginal hysterectomies herein reported, only one case of secondary carcinoma of the cervical stump has come to my attention, despite an adequate and prolonged follow-up of clinic as well as private patients, and this one was due entirely to a stupid error on my part. As a matter of fact, in thirty years I have had only eight cases of carcinoma of the cervical stump following operation by other surgeons. In five of them the malignancy was detected less than twelve months after the supravaginal operation, so that it is logical to assume that the carcinoma was present at the time of the surgical intervention. The other three were discovered five, nine, and twenty-three years respectively after the hysterectomy. With correct preoperative diagnostic precautions and a proper selection of cases, I doubt that the incidence of subsequent carcinoma of the cervix is any higher after a supravaginal hysterectomy than it is in women who have never been operated upon. The statement that "every patient with an amputated uterus is threatened for her lifetime with cancer of the cervix" is of no more significance than the assertion that every adult woman is threatened with carcinoma of the breast.

PREOPERATIVE PREPARATION OF THE PATIENT

Since hysterectomy is, with few exceptions, an elective and not an emergency operation, there is usually an opportunity for thorough preoperative study and preparation of the patient. The assurance of metabolic activity, fortified vital resistance, and mental placidity in each one when she reaches the operating table is an objective just as important as dexterous surgical technique. Toleration of anesthetic agents and surgical trauma decreases in direct proportion to impairment of physiologic processes. The operation should be deferred until an obstipated colon has been unloaded, anemia overcome, respiratory irritations eliminated, constitutional faults corrected, and the efficiency of the cardiovascular apparatus raised to the greatest possible degree. The control of morbidity and mortality is largely a matter of preoperative anticipation and prevention of postoperative complications. In my experience, the most common conditions requiring preliminary treatment are:

1. *Anemia.* Every patient with a red cell count of 3,000,000 or a hemoglobin of 65 per cent or less, should be given one or more blood transfusions. This precautionary measure practically precludes postoperative shock.

2. *Diabetes.* The patient should be put to bed, placed on an appropriate diet, and given insulin if necessary, until the blood sugar falls within normal limits and the urine has been sugar-free for four days.

3. *A Compromised Myocardium.* An electrocardiogram should be made, the patient put to bed for several days, and digitalized if there is marked lengthening of conduction time.

4. *Hypertension.* Hospitalization, with insistance upon physical and mental quiet for several days will generally reduce the blood pressure to a satisfactory extent.

5. *Intestinal Stasis.* A dietary regimen, milk of magnesia or mineral oil, bacillus acidophilus cultures, and a few colonic irrigations will provide a clean gastrointestinal tract.

6. *Pyorrhea.* The patient should be referred to her dentist for dental hygienic treatment.

7. *Large Fibromyomatous Tumors Complicated by Severe Secondary Anemia and Continuous Bleeding.* Just enough Roentgen ray therapy to arrest the bleeding, followed by blood transfusion and tonics, makes operation three weeks later much less hazardous.

Chemical blood examinations, particularly the determination of the carbon dioxide combining power, are of special value in elderly candidates for hysterectomy. Over-enthusiastic preoperative measures, such as starvation and dynamit-

ing the intestinal tract with purgatives, are studiously avoided. All patients are encouraged to drink water freely up to the time of operation. Cathartics are shunned. The evening before the day of operation a light, easily digested supper is allowed, the lower bowel is cleared with a low enema, and a 3 gr. capsule of sodium amytal is given at 9 P.M. Another enema and an iodine douche are given in the morning. The preoperative hypnotic depends chiefly upon the anesthetic agent to be used.

TECHNIQUE

A midline suprapubic incision is the most practical for an attack on large uterine tumors or widespread pelvic pathologic involvements. Adequate exposure is essential for the non-traumatic dissection of peritoneal adhesions, mobilization of entangled viscera, the correction of distorted anatomic relationships, and the freeing of the pelvis of intestinal coils, all of which should be accomplished before the hysterectomy itself is begun. If the incision is necessarily prolonged above the level of the umbilicus, it should be steered to the left to avoid the urachus. The fascia is incised about 2 cm. to the left of the midline, and the left rectus muscle pushed off the linea alba with the knife handle. This zigzags the incision from within outward, permits the left rectus muscle to drop into its normal position without suturing when the incision is closed, and reduces the likelihood of postoperative ventral hernia to a minimum, little if any greater than that following Pfannenstiel wounds.

After the peritoneal cavity has been entered and the pelvic contents completely isolated from the omentum and other abdominal organs, by sharp dissection if they are adherent, the intestinal coils are walled off, using moist laparotomy pads. With satisfactory muscular relaxation as the result of skilled anesthesia and the Trendelenburg posture, no more than one or two properly disposed pads are required. The avoidance of trauma to the omentum, intestine, and mesentery contributes materially to the prevention of shock and a smooth convalescence. Nothing is more insulting to the sympathetic nervous network than an operator fumbling for the uterus and adnexa in the midst of encroaching intestinal loops.

The exploring hand next outlines and identifies the tube and ovary on each side. If they are adherent, they are gently detached by seeking a line of cleavage deep in the cul-de-sac or at the lowest point of attachment on the posterior surface of the infundibulopelvic ligaments. The dissecting fingers mobilize the adnexa from below upwards, keeping the fingertips directed toward the uterus and broad ligaments. Disregarding these details may cause tearing of the adnexa, resulting in embarrassing bleeding. When the adnexa are so densely agglutinated that blunt dissection is not feasible, the operation can be hastened by temporarily excluding them from the hysterectomy and removing them afterward under direct vision.

There are four expedients which facilitate the mobilization of large impacted, grotesquely distributed, and intraligamentary tumors: (1) When the tumor mass is tightly packed into the pelvis, its "delivery" is made much easier by insinuating a soft rubber catheter down to the cul-de-sac between the tumor and the pelvic wall, to permit the entrance of air beneath the tumor. (2) If this proves impossible and the ovarian and uterine vessels are inaccessible on both sides, the top of the uterus can be incised longitudinally and the largest nodules enucleated. This maneuver allows the myometrium to collapse and thus provides additional room laterally. (3) If the ligaments and vessels can be clamped and cut on one side without difficulty, but not on the other, the technique originated by Kelley of cutting across the cervix, and then cutting and clamping from below upward as the vessels are exposed on the impacted side, simplifies what would other-

wise be an awkward procedure. (4) The approach to a large intraligamentary mass is facilitated by incising the anterior leaf of the broad ligament just below and parallel to the round ligament.

It is always of benefit to the patient to abbreviate the operating time as much as possible, but this should be accomplished by the cultivation of dexterity and not by the sacrifice of attention to detail. More than one hour of anesthesia and unduly prolonged maintenance of the Trendelenburg posture may be important factors in the causation of postoperative complications. All abdominal hysterectomies can be done more rapidly, and

Fig. 1. The first pair of straight Ochsner clamps grasp the adnexal structures close to the lateral margins of the uterus.

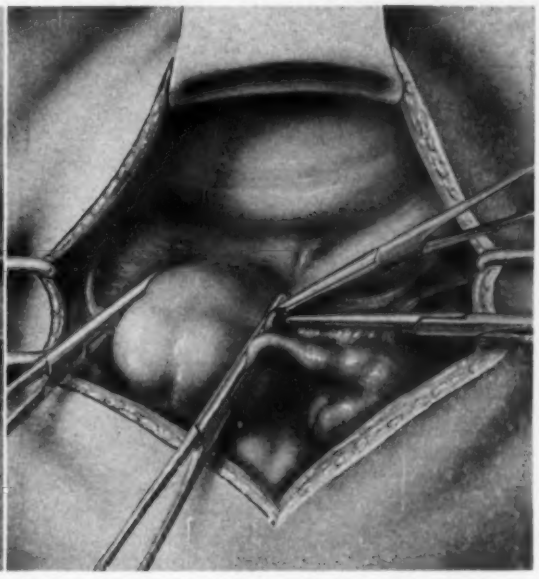


Fig. 2. Application of clamps when the tube and ovary are removed.

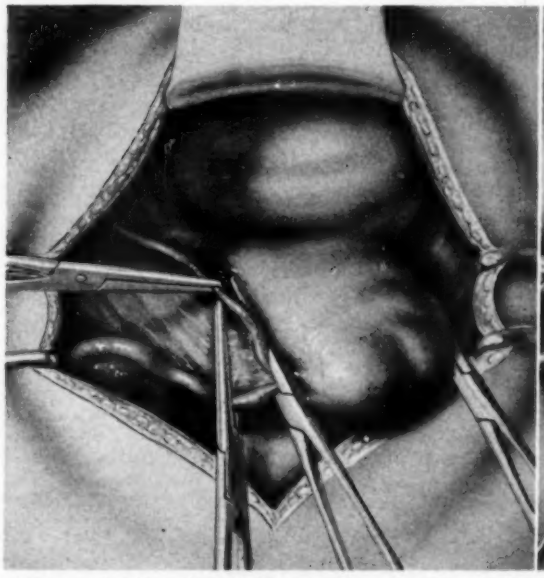


Fig. 3. Application of clamps when the tube and ovary are conserved.

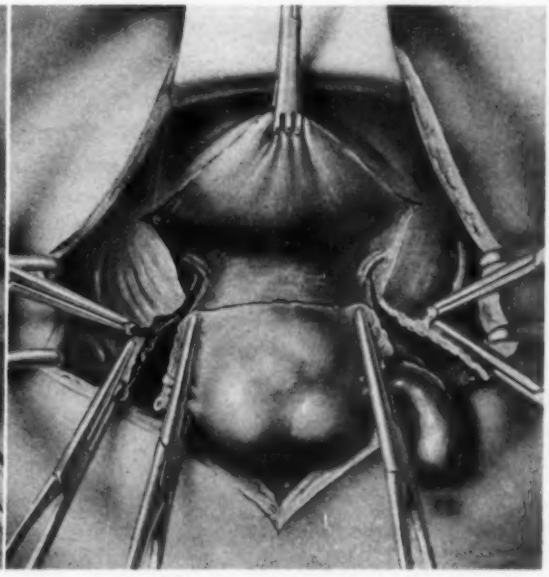


Fig. 4. Mobilization of uterine corpus and bladder. (Anatomic accuracy has been sacrificed to emphasize the technical steps.)

usually with less blood loss, with clamps instead of primary ligatures. Some gynecologists have contended that the use of

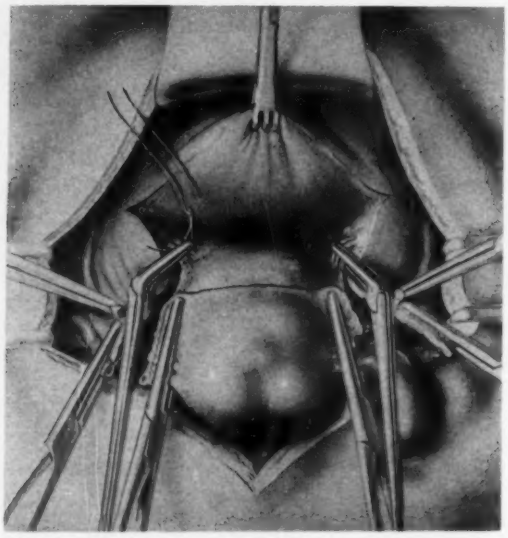


Fig. 5. Faure clamps applied to the uterine vessels.

clamps predisposes to postoperative embolism, but this objection is more theoretical than valid.

Straight Ochsner clamps are used on the uterus and lateral ligaments and Faure clamps on the uterine vessels. The first pair grasp the adnexal structures on each side close to the corpus, and include the broad ligaments, ovarian vessels, round ligaments, utero-ovarian ligaments, and the anastomotic vessels paralleling the lateral margins of the uterine corpus. (Fig. 1.) The tips extend to the margin of the uterovesical peritoneal reflection. The handles of these clamps serve as convenient tractors and, except in the case of huge tumor masses, obviate the necessity for using a corkscrew or large Jacobson clamps, which so often mutilate the uterus. The jaws of the next pair of clamps are placed alongside the first pair, and include either the broad or infundibulopelvic ligaments depending upon whether the tubes and ovaries are to be left or removed. The tips of a third pair are placed on the round ligaments, and the tissues then cut close to the first pair hugging the uterus. (Figs. 2 and 3.)

The uterovesical fold of peritoneum is cut completely across and the bladder pushed down. (Fig. 4.) It is important to

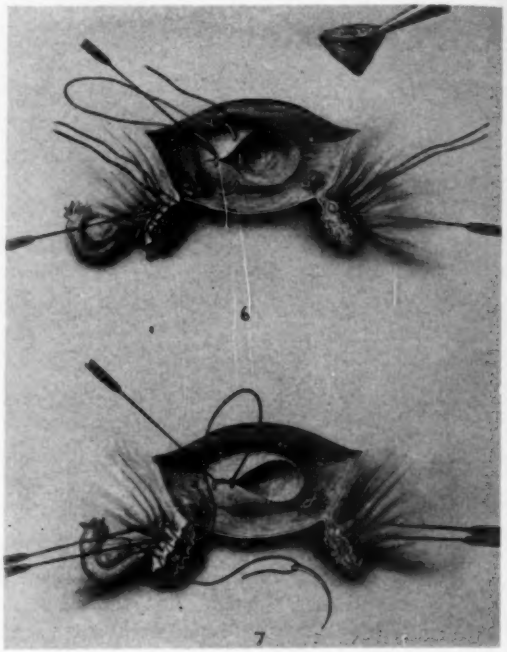


Fig. 6. Ligation of pedicles and uterine vessels, excision of cervical cone, and beginning the closure of the cervical stump.

Fig. 7. Picking up the left broad and round ligament stumps.

dissect the bladder downward just as far laterally as in the midline, in order to dislocate the ureters out of the danger zone. Mobilizing the bladder in the midline only and neglecting its contacts with the parametrial tissues jeopardizes the ureters by making downward traction and bringing them even closer to the cervix. The exposed uterine vessels are secured with Faure clamps, the angulated handles of which lie well out of the way. (Fig. 5.)

After amputating the uterine corpus by a wedge shaped excision at the desired level, the cervical stump is reamed out with a No. 11 Bard-Parker knife blade, which removes most of the endocervix and leaves little more than a disc of cervical tissue in the vaginal vault. The excised area is then swabbed with phenol, followed by alcohol. All of these steps can be executed quickly and permit the introduction of ligatures and sutures in an undistorted and

uncrowded field. In fact, the entire procedure is usually bloodless. Transfixion ligation with No. 2 chromic catgut is safest for securing the uterine vessels, and round and broad ligaments. If a surgical knot is used for the first tie, it will not slip while the second knot is being made. The ends of the ties on the uterine vessels are cut short; those on the ligament pedicles are left long temporarily, to be used as tractors. Closure of the cervical stump, approximation of the structures utilized for its support, fixation of the bladder, and peritonealization of the denuded areas are then carried out by means of a single chromic catgut strand. It is introduced and tied at the angle of cervix amputation on the left side. (Fig. 6.) The needle then picks up the left broad and round ligament stumps (Fig. 7), and as the assistant pulls the long ends of the sutures on the lateral ligaments toward the opposite side (Fig. 8), it is continued from left to right with interlocking stitches to close the cervical stump. (Fig. 9.) It then picks up the ligated ligaments on the right side and brings them down to the cervix too. (Fig. 10.) After cutting the projecting catgut ends on both sides, the continuous suture catches up the margin of the utero-vesical peritoneum and sews it over all the raw surfaces from right to left. (Figs. 11 and 12.) The anterior pelvic fossa and cul-de-sac are wiped dry. It is highly desirable to expose the deepest recess of the cul-de-sac with a ribbon retractor, sponge out all blood clots, and cover the operative field with the rectosigmoid and omentum. These measures are good insurance against subsequent pyrexia and intestinal obstruction. When there are raw areas that cannot be covered satisfactorily otherwise, I have used sheets of gutta-percha tissue to prevent visceral agglutination, bringing the ends out through the lower angle of the abdominal wound.

I am a firm believer in the relative safety of skilfully administered gas-oxygen-ether anesthesia, and utilize other methods only

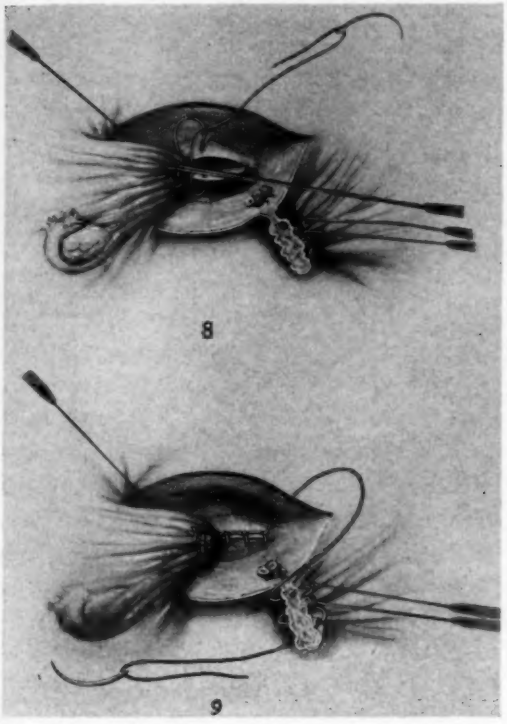


Fig. 8. Attaching the pedicles on the left side to the cervical stump.
Fig. 9. Completed closure of the cervical stump.

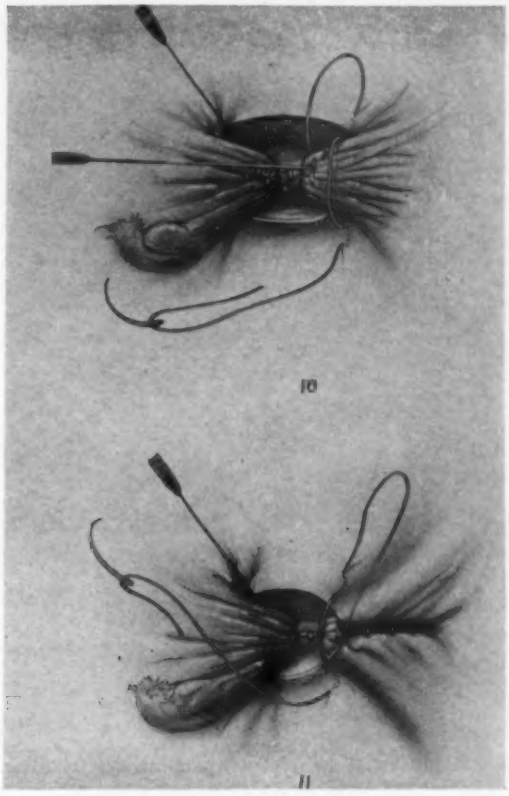


Fig. 10. Attaching the pedicles on the right side.
Fig. 11. Beginning the peritoneal closure.

for some specific reason. All of my patients since 1930 have been rebreathed with 10 per cent carbon dioxide in oxygen before

Fig. 12. Completed peritonealization.

leaving the operating table, irrespective of the anesthetic agent employed.

END RESULTS

I have selected a series of personal cases for evaluation of the end results of supravaginal hysterectomy, because individualities can never be standardized and there are bound to be variable factors involved in the treatment of patients by different members of the same staff. It is far more profitable to criticize ourselves than others. There were complications during convalescence in sixty cases, a morbidity of 11.0 per cent; nine patients died, a mortality of 1.7 per cent. (Table 1.)

Table 1
MORBIDITY AND MORTALITY

Consecutive supravaginal hysterectomies	535
Patients having postoperative complications	60
Morbidity, per cent	11.0
Postoperative deaths	9
Mortality, per cent	1.7

Of course a few patients had multiple complications, so that the incidence of complications is slightly higher than the morbidity percentage.

Abdominal hysterectomy undoubtedly imposes a greater predisposition to post-

Table II
POSTOPERATIVE COMPLICATIONS

Pulmonary	17
Wound	13
Cardiovascular	9
Gastrointestinal	8
Urinary	7
Systemic	4
Hemorrhage	3
Miscellaneous	4
Total	65

operative complications than other gynecologic operations; first, because the majority of candidates for hysterectomy are elderly women; and secondly, because the indications for the operation include the most serious and widespread pathologic alterations in the pelvis. The 535 supravaginal hysterectomies herein reported were done in a series of 2,405 consecutive personal operations, with a morbidity rate of 11 per cent for the operation itself, contrasted with 6 per cent for the entire group.

Table III
PULMONARY COMPLICATIONS

Acute bronchitis	7
Bronchopneumonia	5
Lobar pneumonia	1
Hypostatic pneumonia	1
Pulmonary infarcts	1
Dry pleurisy	1
Atelectasis	1
	17

Pulmonary complications are particularly a menace in short, stocky, and obese women, and are by no means eliminated by basal or spinal anesthesia. It is significant that five of the six cases of pneumonia occurred before 1930, since which date all of my patients have been supplied with carbon dioxide-oxygen pulmonary hyperventilation before leaving the operating table. Any patient manifesting evidence of cough, excessive bronchial mucous secretion, or pulmonary congestion, is also given the same treatment three or four times daily immediately thereafter. Neglect of this latter precaution has probably been responsible for some of the disappointing results that have been reported by those who have relied upon a single prophylactic administration of the gas. A firm refusal to

accept the services of amateur anesthetists also minimizes the incidence of pulmonary complications. One patient had pulmonary atelectasis twenty-four hours after an easy thirty minute operation. She coughed up the bronchial plug eighteen hours later, but developed a bronchopneumonia on the fifth day, and died nine days after operation, the wound disrupting a few hours before death.

Table IV
WOUND COMPLICATIONS

Infection	6
Hematoma	3
Dehiscence	3
Secondary abscess (twenty-ninth day)	1
	13

Unfortunately I have failed to institute standards for postoperative wound classification, and a few that discharged a little serous exudate from a pin-point opening without interfering with primary union have not been designated as infected. One instance of dehiscence developed on the sixth day in a markedly asthenic and anemic patient who developed a bronchitis with a racking cough twenty-four hours after transfusion and operation. Another occurred on the eighth day in a physically vigorous woman. Both of these wounds were resutured under local anesthesia and healed firmly secondarily. The third wound rupture was noted just before death in the patient dying of bronchopneumonia, mentioned previously.

Table V
GASTROINTESTINAL COMPLICATIONS

Acute intestinal obstruction	3
Acute dilatation of stomach	2
Adynamic ileus	1
Pseudo-ileus	1
Fecal fistula	1
	8

Mechanical intestinal obstruction followed the hysterectomy in three cases on the fifth, sixth, and seventh days respectively. In two cases a loop of ileum was found adherent to the infundibulopelvic suture line; in the other, there was a volvulus of the ileum. Two of these patients died, probably because interference was delayed too long. It is possible that some of us have not acquired sufficient surgical aggressiveness in dealing with an impending obstruction.

Acute dilatation of the stomach is no longer a sequel of consequence, since the Levine tube is almost universally employed early to relieve gastric distress.

The fecal fistula established itself in a case of extensive pelvic suppuration, and closed spontaneously.

Table VI
CARDIOVASCULAR COMPLICATIONS

Thrombophlebitis	6
Tachycardia	2
Pulmonary embolism	1
	9

Thrombophlebitis developed in the left leg in four cases, in the right leg in one, and in both legs in one, despite the institution of active motion of the extremities soon after the operation.

Inexplicable tachycardia was noted in two patients who were free from hyperthyroidism and organic heart disease, coming on within the first twenty-four postoperative hours. It persisted for five days in one, and for three days in the other.

The low incidence of embolism may have been due only to extraordinary good fortune, but the practice of active motion of the extremities during convalescence cannot be ignored as a contributing factor. At any rate, it certainly refutes the argument that it is necessary to putter with ligatures before the uterus is removed for fear of possible embolism.

Table VII
URINARY COMPLICATIONS

Acute pyelitis	4
Acute cystitis	2
Suprapubic fistula	1
	7

Postoperative pyelitis and cystitis have been almost eliminated by thorough preoperative intestinal cleansing, the early use of hexamethylenamine and acid sodium phosphate, routine catheterization every six hours for three days, catheterization after voiding so long as there is any residual

urine, and the instillation of 2 drams of 1 per cent protargol into the bladder after each catheterization.

The suprapubic urinary fistula was attributed to the inadvertent puncture of the bladder by the needle used to unite the peritoneum, and closed eight days after the introduction of a retention catheter into the bladder.

TABLE VIII
SYSTEMIC COMPLICATIONS

Surgical shock	2
Acidosis	1
Alkalosis	1
	4

One case of definite surgical shock developed after a prolonged and technically difficult operation, despite a preoperative blood transfusion. The other case was not at all severe.

Acidosis occurred in a patient who became irrational and uncontrollable thirty-six hours after an operation under spinal anesthesia. She died on the fifth day.

Alkalosis was associated with an adynamic ileus which caused death on the seventh day after the removal of a huge fundal and intraligamentous fibroid.

TABLE IX
POSTOPERATIVE HEMORRHAGE

Vaginal (cervical stump)	2
Intraperitoneal	1
	3

Bleeding from the vaginal stump required gauze packing for control in two cases. It occurred on the sixth day in one, and on the eighth in the other. The second was a luetic patient, and the bleeding was probably due to local necrobiosis.

The intraperitoneal hemorrhage was unrecognized until the patient came to autopsy. Her pulse rate remained below 90 for four hours, and then increased to 120 within the next hour. There was no restlessness or air hunger. I did not believe that she was bleeding internally. The autopsy revealed a hemorrhage evidently arising from the right side of the cervical stump beneath the area covered by the bladder. Histologic examination of the cervical stump showed that the uterine artery and vein were firmly encircled by the ligature.

TABLE X
MISCELLANEOUS COMPLICATIONS

Parametritis	3
Abscess of thigh (post-clysis)	1
	4

A unilateral parametritis followed in three cases, in all of which it was necessary to invade the cellular connective tissue of the parametrium to enucleate tumors. The parametritis was recognized promptly and they all cleared up under treatment before the suppurative stage.

An abscess of the thigh developed after a hypodermoclysis of glucose, thoughtlessly given by the resident because he could not penetrate a vein.

DEATHS

Scrutinizing the mortality list, it is evident that the seventh disaster might have been prevented by immediate recognition of the internal hemorrhage, and the third and eighth by an earlier appreciation of a threatened intestinal obstruction. Conversely, the seventh death was probably due to my personal obstinacy, and the third and eighth to a lack of courage to urge surgical intervention soon enough. Disregarding these three deaths which were preventable, the mortality rate of supravaginal hysterectomy in a group of 535 cases would be 1.1 per cent.

CONCLUSIONS

1. Supravaginal hysterectomy is the most popular and widely practiced method of uterine extirpation.

2. Its selection in individual cases should depend more upon the condition of the cervix than the convenience of the operator.

3. Extensive cervical disease, malignancy, and potentially malignant lesions are absolute contraindications.

4. The vaginal surface of the portio must be completely epithelialized and the endocervical canal free from infection and inflammatory products, to justify cervical retention.

5. Many damaged cervices can be reconverted to a healthy state before operation.

6. The incidence of subsequent carcinoma of the cervix is no higher after a supravaginal hysterectomy in properly selected cases than in women who have never been operated upon.

7. Adequate preoperative preparation of the patient is important.

8. Hysterectomy can be done more rapidly with clamps than with primary ligatures and the use of clamps does not predispose to postoperative embolism.

9. When there are raw areas that cannot be satisfactorily peritonealized, sheets of gutta-percha tissue are useful to prevent visceral agglutination.

10. In a series of 535 consecutive personal cases the morbidity was 11.0 per cent and the mortality 1.7 per cent.

11. Eliminating one death which was due to a diagnostic error, and two others which might have been obviated by an earlier appreciation of the necessity of interference to relieve intestinal obstruction, the mortality should have been 1.1 per cent.

TABLE XI

DEATHS

No.	Diagnosis	Operation	Cause of Death
1	Huge fibroid in emaciated elderly woman.	Supravaginal hysterectomy and salpingo-oöphorectomy.	Death from hypostatic pneumonia, twelfth day.
2	Huge fundal and intraligamentary fibroid.	Supravaginal hysterectomy and salpingo-oöphorectomy.	Adynamic ileus. Death from alkalosis, seventh day.
3	Adenomyosis of uterus, salpingo-oöphoritis, pelvic peritonitis, and chronic appendicitis.	Supravaginal hysterectomy, salpingo-oöphorectomy, and appendectomy.	Acute intestinal obstruction and ileostomy, seventh day. Death from exhaustion, twenty-fifth day (autopsy).
4	Fibroid, ovarian cyst, and pelvic peritonitis.	Supravaginal hysterectomy and salpingo-oöphorectomy (spinal anesthesia).	Patient irrational and uncontrollable in thirty-six hours. Died of acidosis, fifth day.
5	Fibroid, ovarian cyst, and partial intestinal obstruction.	Supravaginal hysterectomy, salpingo-oöphorectomy, and mobilization of viscera.	After smooth convalescence, sudden death from pulmonary embolus, eleventh day (autopsy).
6	Secondary anemia, fibroid, and pelvic peritonitis.	Blood transfusion, supravaginal hysterectomy, and salpingo-oöphorectomy.	Simultaneous cessation of respiration and heart beat as peritoneum was being closed—twenty-two minutes.
7	Fibroid, ovarian cyst, and chronic appendicitis.	Supravaginal hysterectomy, salpingo-oöphorectomy, and appendectomy.	Postoperative shock (?) in four hours. Transfusion. Died of internal hemorrhage, nineteen hours (autopsy).
8	Fibroid and pelvic peritonitis.	Supravaginal hysterectomy.	Volvulus and enterostomy, fifth day. Died, sixth day.
9	Fibroid and pelvic peritonitis.	Supravaginal hysterectomy.	Pulmonary atelectasis in twenty-four hours; expulsion of bronchial plug eighteen hours later; bronchopneumonia on fifth day; wound dehiscence and death, ninth day.

THE INTRADERMAL CHANCROID BACILLARY ANTIGEN TEST AS AN AID IN THE DIFFERENTIAL DIAGNOSIS OF THE VENEREAL BUBO*

ROBERT B. GREENBLATT, M.D., C.M. AND EVERETT S. SANDERSON, M.D., PH.D.

Assistant Professor of Gynecology and Experimental Pathology, University of Georgia School of Medicine

Professor of Bacteriology and Public Health, University of Georgia School of Medicine

AUGUSTA, GEORGIA

Introduction. The menacing challenge to the health of the nation by the venereal diseases has invoked a heretofore unprecedented interest on the part of our legislative bodies, the press and the medical profession. Academically, syphilis and inguinal lymphogranuloma hold the spotlight at this moment. Opportunely, however, the reflection brings to light the infection by the Hemophilus ducreyi which has been so much overshadowed. The difficulties encountered in differentiating the various genital lesions—the chancroid from the chancre, the chancroidal bubo from inguinal lymphogranuloma as well as the other venereal buboes—emphasizes the need for a more thorough understanding of the oft ignored chancroidal infection.

In Europe due attention is given to chancroid disease, as the voluminous European literature attests. Dmelcos vaccine prepared according to the method of Nicolle and Reenstierna is widely used for diagnosis and therapy. The paucity of articles appearing in the American literature indicates our complete indifference to this venereal infection. It is to the merit of Cole of Cleveland that he has repeatedly aroused interest in this disease. Cole and Levin,[1] realizing the great need for further diagnostic help in certain moot cases of Ducrey bacillus infection, drew the attention of the American physician to the value of the intradermal reaction for chancroids, using chancroidal bubo pus antigen. In the discussion that followed his report, Eugene F. Traub, David Bloom and others raised certain pertinent points. Why not use a vaccine instead of pus, as is done in Europe? Why the difficulty in growing the Ducrey bacillus in this country?†

In answer to these queries Cole said: "In a way we should make an excuse for a report on a study of this sort using material such as sterilized pus when there is a vaccine on the market, but it is impossible, because of our laws, to get it in this country. It may be that some can grow the Ducrey bacillus with ease; unfortunately that is not our experience in Cleveland. It is a most difficult procedure. We have been trying it for years. . . . Therefore, I feel that until there is a Dmelcos vaccine in this country, there is a place for the employment of a chancroidal pus vaccine of this type."

Two years have elapsed since Cole made these remarks. By his words he instigated further research and we therefore took up the study along the lines in question. We set out to find the method most suitable for the cultivation of the Hemophilus ducreyi which would lend itself with facility to the preparation of a saline bacillary

† By this publication the authors wish to emphasize that a "home-grown" product is available to the physician who heretofore has found European "Dmelcos" unprocurable. The authors wish also to acknowledge the well known European achievements of Ito, Reenstierna, Frei, Nicolle and Durand and others. Their efforts culminated in the commercial production of Dmelcos vaccine. In this country the value of this preparation has been attested by Pardo-Castello, Sulzberger and others.

* From the Gynecologic Granuloma Clinic, the Department of Pathology, and the Department of Bacteriology and Public Health, University of Georgia School of Medicine.

suspension, for use as an antigen in the intradermal skin test.

That we have at least in part succeeded in our purpose can be judged by the fact that we have isolated twenty strains of Hemophilus ducreyi from the aspirated pus of unruptured chancroid buboes and successfully cultivated fifteen strains in pure culture.[2,3] We have found that a saline bacillary suspension makes a satisfactory antigen for use as an intradermal test.[4] The added success met with in our hands is due to the application of several simple principles: (1) that Hemophilus ducreyi grows far better *in* whole blood than *on* blood agar slants; (2) that partial

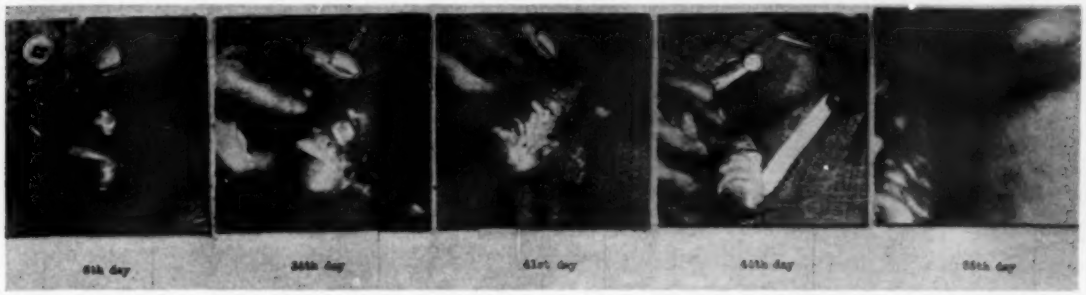


Fig. 1. Typical textbook picture of chancroid disease produced experimentally by the injection of Ducrey bacilli into the preputial fold. Note the multiple penile lesions and the fully developed bubo.

CHART I

PROGRESS OF EXPERIMENTALLY PRODUCED CHANCROIDAL INFECTION

Time	Description of Lesion	Chancroidal Bacillary Test	Chancroidal Bubo Pus Test	Frei Antigen Test	Remarks
1st day	No penile lesion	0	0	0	Inoculation of preputial fold with Ducrey bacilli.
6th day	Ulcerative lesion at site of injection	0	0	0	Smears from lesion reveal Ducrey bacilli and staphylococci.
20th day	Typical chancroidal necrotic ulcer	2 plus (weak)			
34th day	Multiple small ulcers now present on shaft and coronal sulcus	3 plus	0	..	Smears from new ulcers reveal Ducrey bacilli in abundance.
41st day	New crop of ulcers appear on frenulum	3 plus	0	..	Cultures from new ulcers on frenulum yield almost pure growth of Ducrey bacilli in typical chains.
48th day	Early tender bubo present in left inguinal region	3 plus	0	0	Ducrey bacillus separated in pure culture.
55th day	Bubo large, tender with small area of fluctuation	4 plus	2 plus (weak)	0	Smears from aspirated bubo pus reveal no organisms. Culture sterile for Ducrey bacillus.
60th day	Bubo subsiding. Penile lesions healing.	4 plus	2 plus (weak)	0	Antigenic qualities of pus tested, found to evoke weak positive to positive reactions in known chancroid cases.

CHART II

A COMPARATIVE STUDY OF THE SKIN REACTIONS IN A CONTROLLED GROUP OF CASES TESTED SIMULTANEOUSLY WITH DMELCOS VACCINE AND CHANCROIDAL BACILLARY ANTIGEN

	Dmelcos			Control		Univ. of Georgia Chancroid Bacillary Antigen			Chancroidal Bubo Pus Antigen Test	Frei Test	
Case	24 hrs. I E	48 hrs. I E	Reaction in 48 hrs.	24 hrs. I E	48 hrs. I E	24 hrs. I E	48 hrs. I E	Reaction in 48 hrs.			
1. (w) Husband	7–25	10–27	4 plus	2–2	2–2	7–25	10–30	4 plus	positive	negative	H. Ducreyi isolated from lesions by culture.
2. (w) Wife	12–30	12–25	4 plus	2–2	2–2	9–35	8–42	4 plus	.....	negative	H. Ducreyi found in smears from lesions.
3. (w) Male	10–25	12–15	3 plus	1–1	1–1	10–25	13–17	3 plus	negative (antigen #1) positive (antigen #2)	negative	Clinically typical chancroidal ulceration.
4. (w) Male	6–30	9–25	4 plus	1–1	1–2	9–25	8–40	4 plus	positive	negative	H. Ducreyi cultivated from bubo in pure culture.
5. (w) Female	8–30	14–50	4 plus	2–2	2–2	8–30	15–45	4 plus	negative (antigen #1)	negative	Clinically-chancroidal ulcers. Smears suspicious for H Ducreyi.
6. (c) Female	13–15	7–20	3 plus	2–2	2–2	13–14	8–15	3 plus	negative (antigen #2)	negative	Clinically chancroidal ulcers with subsiding bubo.
7. (c) Female	.....	10–35	4 plus	...	0–2	.....	12–40	4 plus	negative (antigen #2)	positive	Draining bubo simulates lymphogranuloma inguinale. History of multiple pudendal ulcers 3 months previously which healed.
8. (c) Male	15–25	15–35	4 plus	1–1	1–2	15–25	15–35	4 plus	positive	negative	Also has granuloma venereum.
9. (c) Male	11–25	10–14	3 plus	1–1	2–2	13–25	10–16	4 plus	positive	negative	H. Ducreyi cultivated from bubo in pure culture.
Controls*											
1. (w)	3–15	2–3	0	2–2	1–1	3–14	2–3	0			
2. (w)	3–15	2–2	0	2–2	1–1	3–14	2–2	0			
3. (w)	.....	2–2	0	...	1–1	.....	2–2	0			

Key: All figures in mm.; I: Indurated zone; E: Erythematous zone; (w): white; (c): colored, 24 and 48 hour readings. Diagnostic readings at 48 hours.

* With our own preparations, several hundred controls have been done.

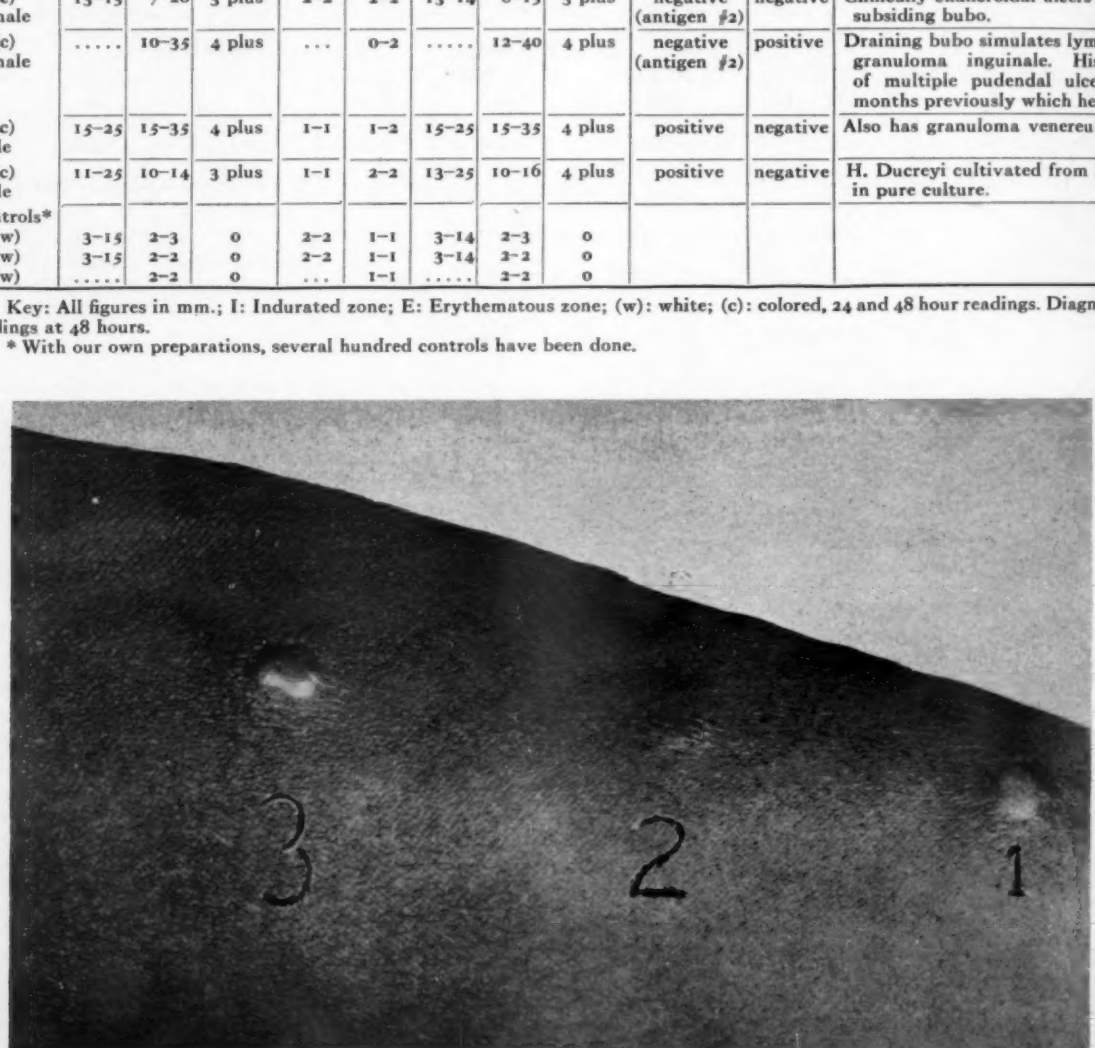


FIG. 2. Intradermal reactions using (1) Sanderson-Greenblatt bacillary antigen; (2) Cole and Levin's bubo pus antigen; (3) Hunt's vaccine. (Courtesy of G. W. Binkley and H. N. Cole, Cleveland City Hospital.)

oxygen tension enhances the growth of the Hemophilus ducreyi, as advocated by Hunt and first used in the cultivation of the gonococcus by Swartz; (3) that though the organism grows more luxuriantly in defibrinated whole rabbit blood, the antigen prepared from the bacilli grown in human blood is apparently more satisfactory.

Several questions naturally arise:

1. What confirmatory evidence have we to support the contention that we are dealing with the causal organism?

2. Should the chancroidal bubo pus antigen, which is of recognized and definite value in diagnosis, be discarded in favor of a bacillary antigen?

3. How does this bacillary antigen compare with Dmelcos vaccine in the intradermal test?

4. Of what aid is the intradermal bacillary antigen test in the further diagnosis of the venereal diseases?

1. *The Causal Organism.* Herbst and Gatewood,[5] in 1912, made a study of chancroid infections and concluded: "Is it not possible that the condition (so long described as Ducrey's disease and presumably due to a specific organism called Ducrey bacillus) is in reality in many instances an infection due to a bacillus belonging to the pseudo-diphtheria group which has been rendered pathogenic through the presence of filth?" In 1918 the British Medical Research Committee[6] reported that "the committee finds no sufficient evidence that what is clinically known as soft chancre or soft sore is a special disease induced by a single species of micro-organisms." As recently as 1935, in V. D. Bulletin No. 89 issued by the U. S. Public Health Service, the following statement is to be found concerning the etiology of chancroid (p. 29): "This is a local disease of the external generative organs in which a sore develops. The cause of this sore is believed to be an infection with a germ, although some physicians question the part which this germ plays." The question naturally arises as to what confirmatory evidence we have to support the contention that we are dealing with the causal organism.

A volunteer patient whose intradermal chancroidal bacillary antigen and Frei tests were negative had a subcutaneous injection of the bacillus of Ducrey into the preputial fold. The organism was from one of our strains isolated in pure culture from a chancroid bubo and which we have kept growing in our laboratory for the past ten months and from which strain we have repeatedly prepared potent bacillary antigen. Chart 1 illustrates the progress of the disease.

An analysis of this crucial experiment yields, we believe, the confirmatory evidence requisite to prove the polemical points in this study. Clinically the patient developed a textbook picture of multiple chancroidal ulcers with bubo formation. (Fig. 1.) Repeated positive intradermal chancroid bacillary antigen tests were obtained from the twentieth day onwards, whereas with bubo pus antigen a weak positive response was obtained only by the fifty-fifth day. The late appearance of the bubo in this case may be due to the inhibitory influence of repeated intradermal tests which we have found of somewhat definite usefulness in therapeusis. The antigenic qualities of the pus recovered from the bubo, and the recovery of a pure culture of Ducrey bacillus from the secondary lesions furnishes the final confirmation.

2. *Antigens.* Should the chancroidal bubo pus antigen, which is of recognized and definite value in diagnosis, be discarded for a bacillary antigen?

Cole and Levin have corroborated the observations of earlier workers, such as Annuzzi, Jersild, Nicolas, Lebeuf and Weigert, and Bratzlavsky and Marenius, that chancroidal bubo pus used as an intradermal antigen would give positive reactions in chancroidal cases. However, it has been noted that Dmelcos antigen gives a more clear cut and stronger reaction. Dulaney,[7] at the University of Tennessee, recently reported a study of

260 chancroidal skin tests performed on 125 individuals, fifty of which were clinical cases of chancroid infection. Many of these were tested with both bubo pus antigen and our bacillary antigen. She reported on the comparable character of the two antigens. Moreover, since weak and doubtful positives were frequently obtained with bubo pus antigen, she concluded that the bacillary antigen was preferable because of the definite character of the reactions. In Cole and Levin's report, one patient with bubo formation, while yielding pus with strongly antigenic properties, nevertheless reacted only weakly to other potent antigens. Figure 2, a photograph taken at Cole's clinic, clearly demonstrates three positive reactions obtained with Hunt's chancroidal vaccine, Cole and Levin's bubo pus antigen and our bacillary antigen. The variation in strength of reaction between pus antigen and bacillary antigen is worthy of note. What constitutes a positive reaction is subject to wide interpretation and what may be considered a weakly positive reaction to one observer may be regarded as a negative reaction to another. (Fig. 3.)

FIG. 3. Note the more definite character of the intradermal reaction to chancroid bacillary antigen (1) and the comparatively weaker reaction to bubo pus antigen (2).

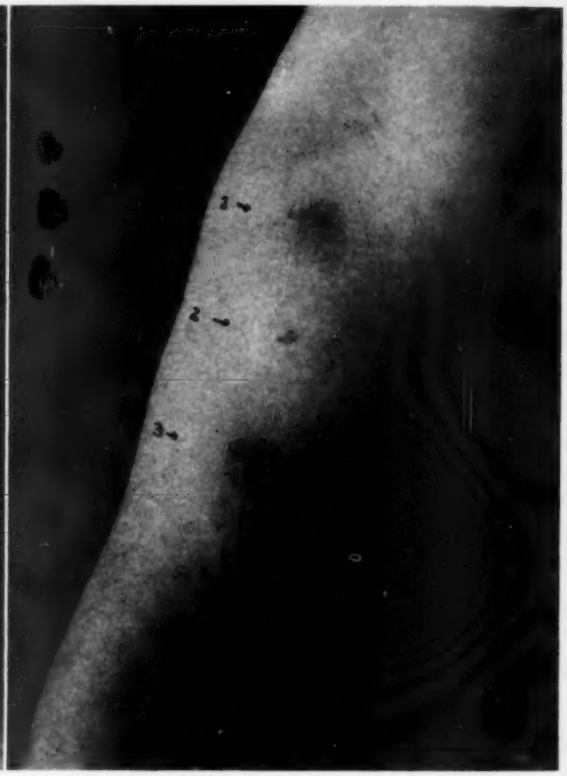


FIG. 4. Note the clear cut intradermal reactions obtained with Dmelcos vaccine (1) and bacillary antigen (3). The control (2) is negative.

In our own series of cases of some 1,100 chancroidal skin tests performed on some 300 patients, the following conclusions were drawn:

1. That bubo pus with strong antigenic qualities is useful, fairly reliable and of definite value.

2. That bubo pus antigen, however, varies greatly in potency, yielding irregular results. The potency of bubo pus varies directly as the amount of antigenic material present.

3. Chancroidal bubo pus is frequently sterile and the Ducrey bacillus cannot be

seen microscopically nor cultivated from it.

4. Bubo pus can be obtained in but limited quantities, cannot be standardized, and is not suitable for distribution.

5. Chancroidal bacillary antigen can be more or less standardized, yields fairly consistent results, can be made up in unlimited quantities, and is suitable for distribution.

3. *University of Georgia Bacillary Antigen and Vaccine.* How does our product compare with the Dmelcos vaccine in the intradermal test?

Dmelcos vaccine is a commercial preparation available in Europe and is prepared according to the method of Nicolle and Reenstierna. The specificity of the intradermal test was recently agreed upon by the French Dermatological Society at Strasbourg in their symposium on chancroid. As pointed out previously, Dmelcos vaccine is unavailable in the United States because of certain governmental regulations. We were fortunate to obtain a small amount, sufficient for twelve intradermal tests, for a comparative study with our own preparation. The results are indicated in the accompanying protocol. (Chart II.) An analysis of the reactions in this small group of cases yields the following facts:

Twelve selected cases, nine of which were known chancroids, were tested simultaneously with Dmelcos vaccine, a control solution, and our own bacillary antigen. Our bacillary antigen and Dmelcos vaccine yielded identical skin reactions in all twelve cases. (Fig. 4.) Of the nine chancroid cases, the Hemophilus ducreyi was either cultivated or found in smears in five, and the remainder had either characteristic lesions or typical histories. The three control cases were individuals free from any history of chancroidal disease. The specificity of the test may be easily surmised from an analysis of the results.

The Interpretation of the Skin Test. One-tenth of 1 c.c. is injected intradermally into the forearm. A non-specific response is usually obtained in the first twenty-four hours, disappearing, however, in the negative case within forty-eight hours. The diagnostic reactions are read at the end of forty-eight hours and are graded from negative to four plus. In the positive cases there appears at the point of inoculation either a papule, a pustule or an indurated zone surrounded by an erythematous halo. Only three or four plus reactions are considered diagnostic. A three plus reaction is one in which the indurated zone measures at least 7 mm. and the erythematous area 14 mm.; in the four plus reaction the zone of induration measures at about 10 mm. in diameter and the area of erythema 20 mm. Occasionally the indurated zone may measure less than 10 mm., but if the erythematous area measures 20 to 40 mm., such a reaction is considered four plus.

The intradermal chancroidal bacillary antigen reaction is specific and will generally show positivity within eight to fifteen days after the appearance of the lesion. If the antigen is inadvertently injected subcutaneously instead of intradermally, no reaction will appear at the end of forty-eight hours. In such cases, occasional delayed positive reactions are obtained in seventy-two to ninety-six hours. Occasional non-specific positive reactions occur which usually cannot be duplicated on subsequent testing. These are very few. Generally the older the lesion the stronger the reaction. Finally, a repeatedly positive reaction, in the absence of any lesion, permits the retrospective diagnosis of chancroidal infection, for the reaction probably remains positive for life.

The chancroidal bubo pus antigen, on the other hand, frequently fails to give well defined positive reactions. In analyzing the protocol, eight of the nine cases that gave positive Dmelcos and bacillary antigen reactions were also tested with chancroidal bubo pus antigen. Four gave clear-cut positive reactions, one gave a weak or negative reaction with one pus antigen and a positive reaction with another. Three gave weak or negative reactions. It is apparent that the reactions obtained with

pus antigen in any one series will vary with the antigenic potency of the pus used. The constancy of the reactions using bacillary antigen, the unlimited quantities possible to prepare, are benefits which are not obtained with pus antigen.

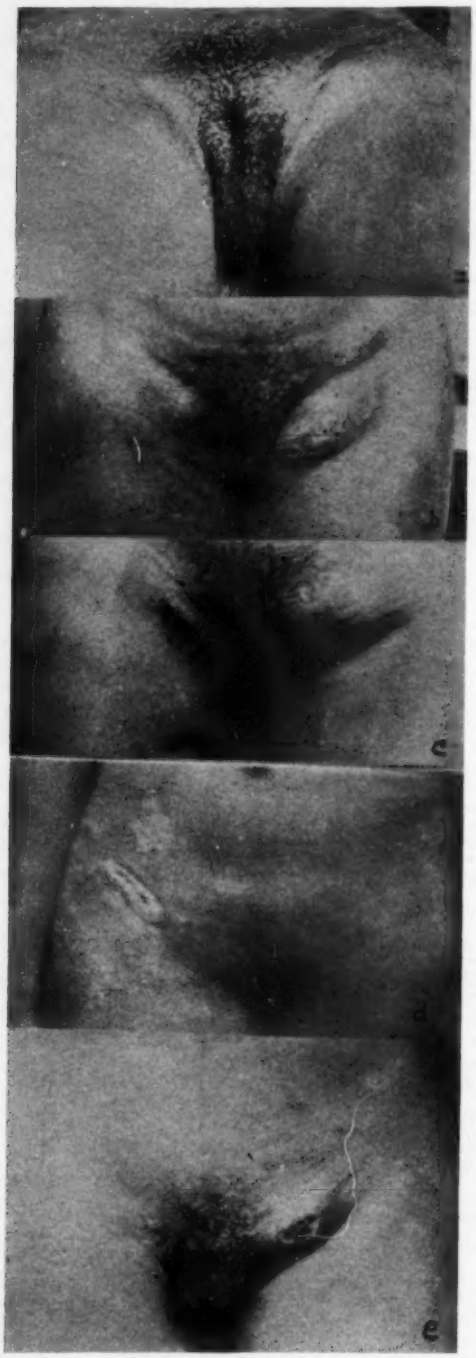


FIG. 5. Venereal buboes: (*a*) luetic; (*b*) chancroid; (*c*) lymphogranuloma inguinale; (*d*) pseudo-bubo of granuloma venereum; (*e*) gonorrheal.

4. *Differential Diagnosis.* Of what aid is the intradermal chancroid test in the further differential diagnosis of the venereal diseases?

Any technical or laboratory procedure which renders negative or positive information in the diagnosis of the venereal diseases is of inestimable value. No one is justified in making a diagnosis of a genital lesion without the aid of the laboratory. The protean manifestations of the five generally recognized venereal diseases are such that each of them may present features which clinically are scarcely discernible from one another.[8] The differential diagnosis of the venereal bubo illustrates this particular point. Figure 5 displays five different types of "venereal bubo" met with in our work. The value and limitations of the intradermal chancroid test is clearly illustrated when applied to the differential diagnosis of venereal bubo cases.

DIFFERENTIAL DIAGNOSIS OF THE VENEREAL BUBOES

The syphilitic bubo, as visualized in Figure 5*a*, is usually bilateral, characteristically firm, showing no signs of inflammatory reaction and practically painless. It does not suppurate unless secondary invasion complicates the picture. Resolution is rapid following antiluetic therapy. Aspiration of the bubo following the injection of a little saline will frequently yield the treponema, thus anticipating the diagnosis through blood serology by days to weeks. The intradermal chancroid bacillary antigen test here serves its purpose in that it rules out the most common complication of syphilis, that is, coincident chancroidal infection.

The chancroid bubo (Fig. 5*b*), is usually unilateral, reaches a moderately large size, is unilocular, with marked tendency to early suppuration. A definite inflammatory reaction occurs, as is evidenced by erythema of the surrounding skin. Tenderness and pain are usually present. Spontaneous rupture of the bubo may occur with consequent healing or may be followed by a

recalcitrant serpiginous ulceration. In the case demonstrated here both the chancroidal and Frei tests were positive. In studying the smears of the aspirated pus no organisms could be demonstrated. On culture, however, a pure strain of the Hemophilus ducreyi was obtained, thus presumably establishing the diagnosis. It is apparent that in this case the positive chancroid skin test in the presence of a positive Frei test was only of limited value. Culturing the pus whenever possible is a valuable adjunct in diagnosis.

The bubo of lymphogranuloma inguinale (Fig. 5*c*), is usually unilateral, occasionally bilateral. Moderately massive adenopathy occurs and is characteristically multinodular with adherence of the overlying skin, which frequently assume a bluish hue. Typical are the areas of alternating softness and hardness and the suppuration with drainage through multiple fistulae. The bubo may remain indolent, without suppurating or resolving for many months. In this particular case, repeated chancroid skin tests and blood Wassermann tests were negative, the Frei tests positive and the aspirated bubo pus sterile for organisms. The negative intradermal chancroid bacillary antigen tests were of value in this case in that they ruled out chancroid as a concomitant infection, enabling us to use the aspirated pus for Frei antigen.

Pseudo-bubo of granuloma venereum (*inguinale*) (Fig. 5*d*), is not an inguinal adenitis but a subcutaneous granuloma which swells and finally ulcerates. The inguinal lesion may be primary or secondary to a genital lesion. In the early stages the inguinal swelling usually resembles an ordinary bubo. Textbooks remark that the regional lymph glands are usually uninvolved. While this statement is correct, it is misleading unless the conception of the pseudo-bubo is stressed to orientate one in the recognition of this manifestation.[10] In this case the chronicity of the lesion and the peculiar pinkish granulomatous ulceration, with raised, clean-cut edges, led us to suspect granuloma venereum. Donovan bodies were demonstrated in smears. In instances where the Donovan bodies cannot be readily demonstrated in smears, the diagnosis can be greatly facilitated by histologic study of biopsy material.[9] The characteristic histopathology and the presence of the pathognomonic cells are diagnostic. The negative Frei and chancroidal skin tests in this particular case were of evident value.

Gonorrheal bubo (Fig. 5*e*), is usually unilateral, clinically resembling the chancroidal bubo. In this case the diagnosis was unsuspected. Smears from the aspirated bubo pus revealed no organism other than occasional gram-negative intracellular diplococci. The pus yielded this organism in pure culture. Biochemical tests identified the organism as the gonococcus. Repeated Frei and chancroidal skin tests were negative. The chancroid bacillary antigen skin test, though negative, yielded positive information in that it ruled out chancroidal infection which this bubo so closely simulated. The literature is notoriously vague on the question of the gonococcal bubo. Many textbooks fail entirely to mention it. Proved cases, we are led to believe, are quite rare.

CONCLUSIONS

1. A typical textbook picture of chancroid disease in all its phases was experimentally produced in a human by the injection of Ducrey bacilli into the preputial fold. The organism used for this experiment was isolated in pure culture from a chancroidal bubo and maintained in our laboratory for ten months. Two additional facts which should serve to dispel the widespread doubts as to a specific causal organism in what is clinically known as soft sore or chancroid are: (1) the re-isolation in pure culture, by separation, of the Ducrey bacillus from the secondary lesions; (2) the pus aspirated from the experimental bubo had specific antigenic qualities in that positive skin tests were evoked in known cases of chancroid infection.

2. The Hemophilus ducreyi is indeed a difficult organism to grow. We have found that it can be cultivated with moderate success by growing it beneath the surface of whole defibrinated human blood. The bacillary antigen prepared from such cultures is preferable to bubo pus antigen as a diagnostic skin test. Experience has shown that the former gives consistently stronger and more clear cut reactions than the latter. The antigenic quality of chancroidal bubo pus, moreover, is variable, while that of bacillary antigen is quite constant.

3. In Europe the specificity of Dmelcos vaccine as a diagnostic procedure for chancroid is generally agreed upon. The chancroid bacillary antigen as prepared by the authors gave reactions identical to those of Dmelcos vaccine in a selected group of cases.

4. The intradermal chancroid bacillary antigen test is an aid in the differential diagnosis of genital lesions. The buboes of syphilis, gonorrhea, chancroid, inguinal lymphogranuloma as well as the pseudobubo of granuloma venereum frequently simulate one another. A positive intradermal chancroid test commits one to the diagnosis only when the Frei tests, blood Wassermanns, biopsies or smears for granuloma venereum, etc., are negative. A repeatedly negative test is of diagnostic value in that it rules out chancroid disease. One must constantly bear in mind that the various venereal diseases may occur simultaneously in any combination or permutation. A positive chancroid skin test, therefore, in the presence of a positive Frei test, etc., is only presumptive evidence and can be interpreted as diagnostic only when bolstered by other laboratory evidence such as the cultivation of the Ducrey bacillus.

The authors gratefully acknowledge the aid rendered by Dr. Robert B. Dienst in identifying and cultivating the gonococcus from the bubo shown in Figure 5e.*

REFERENCES

1. Cole, H. N., and Levin, E. A. The intradermal reaction for chancroids with chancroidal bubo pus. *J. A. M. A.*, 105: 2040 (Dec.) 1935.
2. Sanderson, E. S., and Greenblatt, R. B. The cultivation of Hemophilus ducreyi and preparation of an antigen for intracutaneous diagnosis of chancroidal infection. *South. M. J.*, 30: 147 (Feb.) 1937.
3. Greenblatt, R. B., and Sanderson, E. S. Chancroidal vaccine. *Am. J. Clin. Path.*, 7: 193 (March) 1937.
4. Greenblatt, R. B., and Sanderson, E. S. The diagnostic value of the intradermal chancroidal skin test. *Arch. Dermat. & Syph.*, 36: 486 (Sept.) 1937.
5. Herbst, R. H., and Gatewood, L. C. Experience with a vaccine in the treatment of chancroids. *J. A. M. A.*, 58: 188 (Jan.) 1912.
6. Medical Research Committee, Special Rep. Ser. No. 19, p. 47, 1918. (Quoted by Saelhof, Clarence C., Observations on chancroidal infection. *J. Infect. Dis.*, 35: 591, 1924.)
7. Dulaney, A. D. The use of Ducrey vaccine in diagnosis. *Am. J. Syph., Gon., & Ven. Dis.*, 21: 667 (Nov.) 1937.
8. Greenblatt, R. B., Sydenstricker, V. P., and Pund, E. R. The fourth and fifth venereal diseases. *J. M. A. Georgia*, 26: 16 (Jan.) 1937.
9. Pund, E. R., and Greenblatt, R. B. The specific histology of granuloma inguinale. *Arch. Path.*, 23: 224 (Feb.) 1937.
10. Dienst, R. B., Greenblatt, R. B., Sanderson, E. S. Cultural studies on the Donovan bodies of granuloma inguinale. *J. Inf. Dis.*, 62: 112 (Jan.–Feb.) 1938.

* Since the submission of this article for publication the Lederle Co. has listed Ducrey vaccine among its products. The authors have coöperated with this company to make this vaccine available for general use.

RHYTHMIC SURGERY

W. H. LAWRENCE, M.D., F.A.C.S. AND C. H. BERRY, M.D.

Summit Medical Group

SUMMIT, NEW JERSEY

THE general term rhythm applies to measured and balanced movements wherever found, as in poetry, music, industry and sports. Success in any field where manual movements are required is marked by outstanding rhythm. Rhythm is therefore essential to the smooth performance of a surgical operation, and surgeons in particular should be eager to accept opportunity to develop ease and natural rhythm in their work.

Measured motion and smooth flow are characteristics of some master surgeons and account for their great technical skill, but this skill cannot be passed on to others without some way of recording it by diagram or the written word. Motion study, as developed in industry, furnishes us a means to this end.

A study of the hand and arm motions of those engaged at the operating table has shown a surprisingly large number of useless motions, many which, to say the least, are ineffective, and many, which through their very awkwardness, must rapidly produce fatigue. While making a study of surgical technique in general, we were greatly impressed by these findings, and in the search for a way to correct them we studied the developments of efficiency in the workshop. We now believe that all surgeons can achieve real skill and true rhythm through motion study of their own activities. Thus, we are convinced that the practice of motion economy, as applied to industry, should be widely used in surgery.

Motion study is the analysis of the manual movements of the instruments and equipment used in the performance of an operation. This analysis is carried on with the purpose of finding the 'one best way' of doing this work, standardizing the technique, instruments and equipment, and training the workers in these methods. To find the 'one best way' of performing the operation, a minute analysis of the movements made by the surgeon in operating is a valuable approach to the problem.

We made these studies for the purpose of eliminating all unnecessary motions, making such motions as we do use more effective, and building up a sequence of the most motions for maximum efficiency.

Motion study was first brought before the public by Frank Gilbreth about thirty years ago, and has since developed into a real science, which is being taught in most of the large universities of this country and abroad. Gilbreth found that it could be applied to any work done by the hand, and that, if properly studied and applied, it was productive of an amazing increase in efficiency, resulting not in speed-up, but rather in "no haste, no waste." Naturally, he was particularly interested in industrial matters, yet he did take time to study the work of surgeons; he expected to find among men who had a human life at stake examples of the greatest skill in the use of their hands. He visited clinics in this country and abroad, and was much surprised to find a total lack of standardization of practice, and said "Industry has nothing to learn from the skill of surgeons, but the surgeon has much to learn from the skill of other artisans."

In 1916 Mr. Gilbreth[1] read a paper before the hospital section of the American Medical Association in which he pleaded for a study of motion economy and standardization of surgical movements, and went on to say:

"One hindrance to rapid progress in standardizing work in the industries has been the occasional lack of understanding of the aim of such measurement, and the

consequent dislike in some instances, if not more active resentment, to having activity accurately measured. There is excuse for a skilled, each one trained with the best methods first, and ready to teach the work efficiently to others who are fitted for it; it

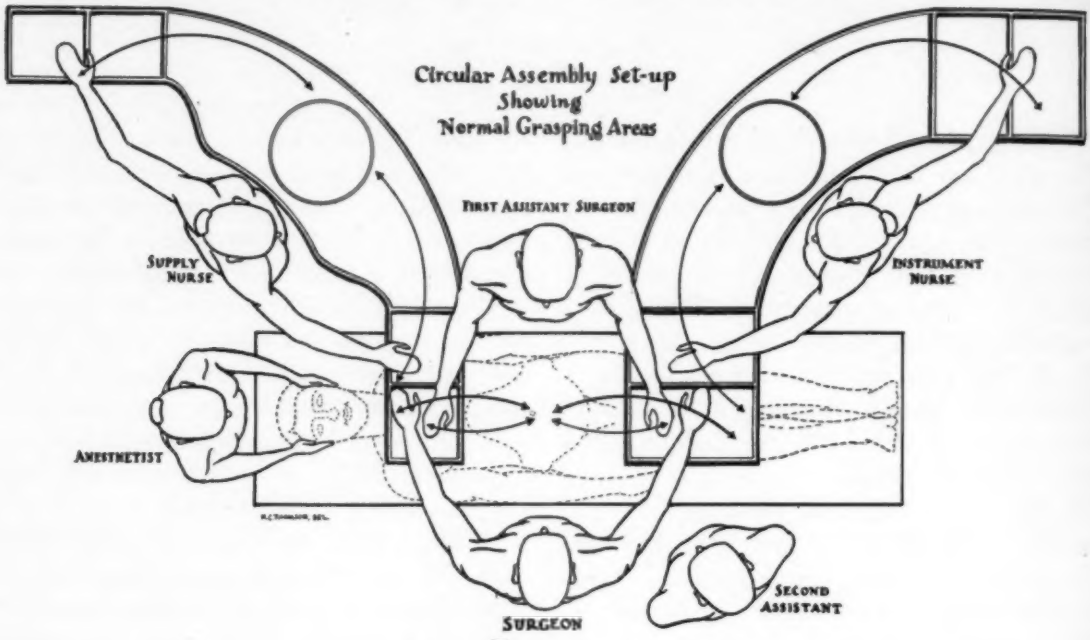


Fig. 1.

man of the industries, who has not had the advantage of either a general or a special education, being opposed to something that is quite extraordinary and new to him, and that has often been misunderstood. There is absolutely no excuse for the surgeon, who rejoices in a general and special education, which is broader than that enjoyed by any other profession in the world, not understanding exactly what the science of management is attempting to do, and not stepping forward as a body to lead the way in this great achievement of the twentieth century, and we call upon you surgeons today to volunteer collectively and individually, in as far as lies with you, not only personally to help in the work, but to demonstrate to others its necessity and importance.

"It is obvious that the results of your so doing will be a great help to science and a benefit to the entire world. It will mean the establishment of at least one standard hospital with standard practice, and the dissemination of standards—which is not today possible; it will mean a race of super- will mean coöperation which is based upon a knowledge of what should be done, how it should be done, and who can best demonstrate and teach it; it will mean the elimination of waste so enormous that no other waste in the world equals it; finally, it will mean the conservation and increase in the output of happiness minutes, the ultimate unit in which the work of the surgeons is measured."

As far as we can find, very little, if anything, has come from Gilbreth's efforts in the last twenty-two years. The only effort to make use of 'work simplification' principles in surgery that we have been able to find was done by Dr. Eugene H. Pool and Frederick W. Bancroft[2] in the New York Hospital in 1917, in an article entitled "Systemization of the Surgical Service," and from this paper we quote:

"An effort to simplify the work in the operating room has been made. The properly trained operating staff should be a well balanced machine; it is, however, difficult to attain this end. In the average hospital each member of the attending

staff has his individual ideas as to the arrangement of the operating room and of instruments, etc. It often becomes necessary to arrange the room and to plan certain details, even of routine operations, differently for each man. The lack of uniformity interferes with the fixed policy, leads to confusion, and imposes a greater burden on the helpers. All routine operations should be standardized: the arrangement of the room should be uniform, a given number of instruments should be on the tray, and the same suture materials and instruments should be used. As far as possible, the same incision and procedure should be employed."

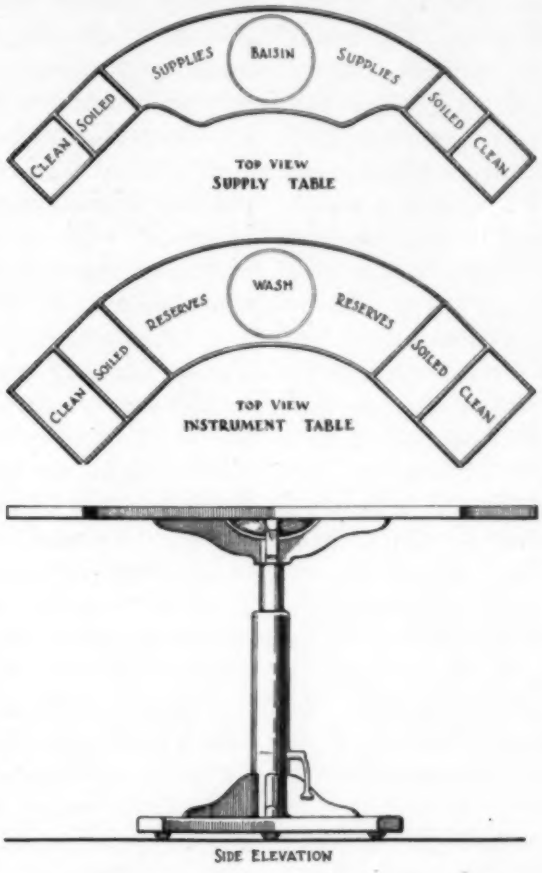


FIG. 2.

They also developed a system of hand signals for the passing of instruments from nurse to surgeon, but no complete motion study was developed.

We believe that it is high time for surgery to try out these "work simplification" principles and apply them to the operating room. There may be a number of good ways of doing a thing, but there is only 'one best way.' This has been scientifically proven in industry, and we believe that there is 'one best way' of performing a surgical operation. If this is so, we can look forward to standardization of the motions required in any operative procedure. It may be possible to have the master surgeons agree on the 'one best way.' Certainly, a study of motion economy by many good surgeons might very well lead to agreement and to accepted practice.

Certain fundamental principles of 'work simplification' must be the basis for any study undertaken for the systematization of procedures in the operating room. These consist of:

1. *Proper Working Place.* This should mean not only a well chosen room, the proper lighting, but particularly the proper

equipment, arranged in such a way as to permit the use of all the principles of motion economy. Early in our studies we found it necessary to make changes in the accepted operating room set-up. The usual arrangement of instrument and supply tables away from the operating table was the cause of much useless motion and delay, and so the circular assembly set-up, as applied in industry to simplify work, was applied to the surgical and supply tables.[3] In this way we evolved tables with normal grasping area. (Figs. 1 and 2.)

The advantage of such tables is that the 'prelocation' of instruments and supplies puts them at all times within the 'normal grasping area.' Placing the instruments and supplies on each side of the surgeon and the assistant favors development of 'two hand consciousness.' Such an arrangement also enables the instrument and supply nurses to face the operative field at all times, avoiding the necessity of turning about to reach for the necessary article (ordinarily located behind them), and so lessens the danger of a break in aseptic technique on the part of the nurses, as well as eliminating useless motions.

The tables themselves are conveniently built with removable metal tops, which are readily sterilized. The built-in basins are convenient for cleansing and replenishing, and the division for clean and soiled instruments makes for delicacy in technique as only two places are soiled, and frequent changes of covers prevents the spectacle of a bloody operation.

We consider the use of some such arrangement of the work place to be of primary importance in the development of true rhythm in surgery.

2. *Proper Instruments.* Motion economy demands careful supervision over the character, number, and proper use of instruments. The questions: Are the instruments the best qualified for the work in hand? Are they in good condition? Is there any great excess of instruments at hand? Is the operator trained in the proper use of each instrument?—must be answered. The vast multitude of instruments and gadgets brought out in recent years by as many different surgeons should be subjected to a critical study. Large numbers of them should be discarded, and emphasis placed upon a minimum number of carefully selected tools for the work in hand. The operator should become entirely familiar with *each* of his instruments and the exact manner of their use to avoid such things as haggling with a knife, grabbing large chunks of tissue in the hemostat, or cutting too close to a tie with the scissors.

3. *Prelocation of Instruments.* Each of the commonly used instruments should have an exact prelocation and be arranged much as the keyboard of a console. This should lead to the development of the touch system, enabling the surgeon and his assistant to reach for and grasp the desired instrument without taking his eyes away from the wound, much as a pianist or a typist striking his keys. The instruments not so commonly used should be prelocated by the instrument nurse so that she can reach and grasp them, pass them to the surgeon without delay. It is for these less commonly used instruments that hand signals prove most useful.

4. *Normal Grasping Area.* All things to be used by the individual should be within the normal grasping area. The maximum grasping area should no more come into play in the operating room than at a well conducted dinner table. Instrument and supply tables should be so arranged as to favor the use of both hands. The development of 'two hand consciousness' is a most important principle of motion economy. Rhythm of movement is a natural outcome of motion study, is productive of efficiency, and pleasing to the onlookers.

A study of these principles and the application of them through motion study is no arduous task, but a duty that becomes fascinating as it progresses.

WHAT CAN MOTION STUDY DO FOR SURGERY?

1. *Standardize.* Motion study furnishes a way to standardize surgical operations

and makes possible the transference of manual skill from the expert to the beginner. Waste in the transference of skill must be eliminated. With motion study we have scientifically arranged measured facts to guide us instead of a tradition, personal opinion, or judgment, possibly coming from familiarity with many wrong methods.

At the present time master surgeons have their own technique, and each technique differs radically from the others. This may do well for master surgeons, but is it good for the rank and file of men doing surgery? Different operating room equipment and set-up, different instruments and supplies, different methods, and above all, different motions, make one doubt which surgeon, if any, has found the 'one best way.' Ask the operating room supervisor of any active hospital of her troubles in answering the demands of the various surgeons who operate there.

The student who trains under one of the many master surgeons follows the particular technique to which he becomes accustomed, but he makes an awkward partner fit when he teams up with a man who has become wedded to an entirely different technique.

Older surgeons, unless they are of the lucky ones with permanent staffs, have all suffered alike from the awkwardness and the lack of real assistance on the part of temporary first assistants. This is especially noticeable if the assistant happens to be a follower of some other surgeon. Often these young surgeons argue that any work differing in even the slightest degree from the manner of their own surgical preceptors is wrong. The situation is similar to that of a bridge-player following one school of bridge, while everyone at the table follows another. Good teamwork can only be expected if all understand the same technique. A written standard practice giving detailed routine of the operation is the most common and satisfactory way of preserving the standard.

A standard of motion economy will prove its greatest value in the training of men starting on a surgical career. With an accepted standard of procedure, each movement can be taught in the beginning, and real manual skill attained in a short time. These men have no bad habits to unlearn. They are taught many things to do, but how to do them is difficult to learn from the present literature. Many recent graduates have told us that they had had no teaching in the proper use of any instrument. It is only when the science of motion study is applied to this problem, when the individual surgeon studies it from this angle and becomes 'motion conscious,' that we can hope for progress toward uniformity. It is our sincere belief that this standardization is one of the things most needed in the surgical field of today.

2. *Improve Methods.* Motion study can improve the methods of every man who calls himself a surgeon. One may be rather well satisfied with the way he has carried out a particular operation, but if this same operation were subjected to critical motion study, many faults would become apparent to the surgeon himself.

We have been surprised, in spite of our sense of security from criticism, to find glaring errors when viewed in the light of motion economy, and as revealed by the motion picture camera. A useless motion here, an ineffective motion there, awkwardness on the part of some one of the surgical team, and inexcusable delays, add up too often to the distinct detriment of the patient. 'work simplification,' if understood and applied, leads to rapid, neat and smooth action.

In the art of surgery simplicity is the keynote. Someone has said that success depends upon details, but success is no detail. Every movement should have a purpose, every action achieve something, and under the guidance of motion study it is possible to approach this ideal. Motion study furnishes the only known way by which operations can be standardized.

3. *Time Saving.* Motion study reduces sharply the length of time required to do an operation. Speedy operating is to be deplored, but leaving the abdomen open one minute longer than absolutely neces-

sary should be abundantly criticised. Having a place for everything and everything in its place, rhythmic, effective motions on the part of the whole team, synchronously arranged and followed in minute detail, a standard set by those qualified to do so, will result in real time saving. We especially wish to note that this is not a speed-up, but rather a case of 'no haste, no waste,' and that the time saving comes entirely from the economy of motions and improved sequences, without increase in the rapidity of any motion. No one will deny that a short, well conducted operation is desirable from the standpoint of decreased morbidity and mortality.

4. *Reduction of Fatigue.* Motion study is abundantly worthwhile when it reduces the fatigue factor of the surgeons and nurses. One of the factors of motion economy is the establishment of a proper work place. With the circular assembly set-up of instrument and supply tables it is practical to have the whole operating force seated. An instrument nurse that has to stand at attention several hours at a stretch may well have headache and backache—and we do see exhausted surgeons. The most delicate details of technique are most easily carried out in the sitting position. Why not sit on proper stools with back rests, at least during the longer operations?

Rhythmic movements, with everything reached for well within the grasping area and with each hand doing its full share of work, lessens fatigue. As routine procedures, such as the approach to and exit from the pathology following standard forms, become practically automatic, the mind of the surgeon is free to concentrate on the critical part of the operation. Quoting Monahan: "An operation should be the work of an artist, not merely a hewer of flesh. It should bring a glow of keen delight to the artist himself, a thrill of joy, and a sense of complete satisfaction to a critical spectator." Tired nurses and an harassed surgeon can not be expected to bring about this beautiful result.

5. *Limiting Armamentarium.* The natural laws and underlying principles relating to efficiency resulting from the design, standardization, care and use of tools are as clearly defined as the laws of mathematics, and those laws are the same for all tool users, including surgeons. The adoption of motion study would cause the elimination of large numbers of instruments now being used, and there would be concentration on the development of fewer instruments of the best design. The larger the number of instruments, the less practice a surgeon can have with any of them, but with a lesser number, the chances of becoming expert in their use are decidedly enhanced. This makes not only for economy of effort, but a large financial saving also.

CONCLUSION

Much of motion study is done away from the operating theater. The training and technique need not necessarily be done on a living patient. An operating room set-up can be arranged away from the hospital, and regular drills in operative technique will prove invaluable to the young surgeon. We have had many interesting and instructive hours at dummy tables, with discarded instruments, performing operations in pantomime. One acts as surgeon and calls off the steps, and the assistants act their parts. A piece of steak wrapped in oil silk takes the part of patient. With wall charts and moving pictures of previous operations we can correct faults, get new ideas, practice motion economy, and have a good dress rehearsal. Is not the patient attending the 'opening performance' entitled to a well drilled company? Yes! motion study can be properly included in the curriculum of the senior year in medical schools.

REFERENCES

1. Gilbreth, F. B. Motion study in Surgery. *Canad. J. Med. & Surg.*, July 1916.
2. Pool, E. H., and Bancroft, F. W. Systematization of a surgical service. *J. A. M. A.*, 59: 1599–1603 (Nov. 10) 1917.
3. Mogansen, A. H. How to set up a program for motion economy. Factory Management and Maintenance. Plant Operation Library. 93: S143 (Nov.) 1935.

THE EFFECT OF ETHER AND SODIUM AMYTAL ANESTHESIA ON THE BLOOD*

PAUL W. SEARLES, M.D.

Fellow in Anesthesia, The Mayo Foundation

ROCHESTER, MINNESOTA

IN the literature are numerous reports concerning the concentration and coagulation of the blood during ether anesthesia. Recently, concentration of blood in the course of anesthesia with sodium amytal has received considerable attention, but the results of these investigations have not been uniform. The observations for the most part have been made on clinical patients subjected not only to the anesthetic but to some operative procedure as well. It has been the purpose of this research to investigate the uncomplicated effect of ether anesthesia and sodium amytal anesthesia on the number of erythrocytes in the blood and to establish the uncomplicated effect of ether anesthesia on the coagulation time of the blood plasma.

The majority of the investigations concerning the effect of ether anesthesia on the number of circulating erythrocytes have shown an increase. Hamburger and Ewing found an increase of 15 per cent in hemoglobin and 10 per cent increase in the erythrocytes of dogs, following ether anesthesia. Barbour and Bourne showed that in fasting dogs, which were allowed to have water up to the time of the experiment, there was an increase in blood solids during ether anesthesia. This increase ranged from 2.1 to 3.4 per cent. Bourne found in a second series of dogs, with an elevation of the environmental temperature to 33°C. and administration of fluids beforehand, that negligible changes in body temperature and blood solids occurred when the dogs were anesthetized with ether. Morphine administered prior to the ether anesthesia also protected the animal against the concentration of blood.

Drabkin and Edwards found that the administration of sodium amytal did not produce any change in the solids of the blood. However, Bourne, Bruger and Dreyer, who conducted experiments on both dogs and men, found that a definite decrease in the solids of the blood was produced by sodium amytal anesthesia; the maximal decrease occurred one hour after its administration. They observed a marked enlargement of the spleen when phenobarbital sodium (luminal) was administered and suggested that this might also be true with sodium amytal. Adolph and Gerbasi concluded that the blood solids of dogs were greatly decreased when sodium amytal was administered. They splenectomized one dog and found that no change occurred in the blood solids under sodium amytal anesthesia.

There exists a wide variation of results concerning the effect of ether anesthesia on the experimental animal. Two of the most accurate observations were made by Mendenhall and by Zopff. Mendenhall, who experimented on decerebrated cats and who used whole blood, found an average decrease of 15 per cent in the clotting time of the blood, and explained this decrease on the basis of a stimulation of the adrenal glands. A closer analysis of his results shows that in some of his experiments there was an actual increase in the time required for the formation of a clot, whereas in others there was no change at all. Zopff, who experimented with dogs and who used a much smaller number of animals than did

* Abridgment of thesis submitted to the Faculty of the Graduate School of the University of Minnesota in partial fulfillment of the requirements for the degree of M.S. in Anesthesia.

Mendenhall, confirmed these results. In addition to observing a decrease in the coagulation time, Zopff found an increase in the platelet count during and after ether anesthesia.

EXPERIMENTAL PROCEDURE

The experiments were confined to healthy normal dogs. Two blood samples were withdrawn as controls prior to the administration of the anesthetic, care being taken to insure a minimum of excitement during the process. The blood was withdrawn from the cubital, saphenous or jugular veins, a different vein being selected for each puncture. The anesthetic was administered immediately after the control samples of blood had been taken. Ether anesthesia was induced in an ether chamber and maintained by the auto-inhalation method.[10] Light surgical anesthesia was maintained for the first thirty minutes and deep surgical anesthesia was maintained for the next thirty minutes. When sodium amytal was used, 50 mg. of the drug for each kilogram of body weight was injected intravenously. During anesthesia, duplicate samples of blood were collected at the end of the first and second periods of thirty minutes. In addition, samples of blood were collected after anesthesia. In the case of ether, this was done one hour after the administration of ether had been discontinued, while with sodium amytal an arbitrary period of four hours after induction of anesthesia was chosen.

The values for hemoglobin were determined by the Sheard-Sanford photo-electric method.[14] Hematocrit studies were made by the use of standard tubes. For the hematocrit reading, the blood was drawn into heparin and the tubes were centrifuged for thirty minutes at approximately 1,500 revolutions per minute. The erythrocyte counts were made by the use of standard hemocytometers. The clotting time was determined by using the blood plasma coagulability test; the end point was detected by the use of the coagulometer devised by Baldes and Nygaard. This technique requires the use of a photo-electric cell. The number of blood platelets was determined by Nygaard's[12,13] modification of Thomsen's direct method of counting platelets in oxalated blood.

RESULTS

Each of three dogs was anesthetized with ether on three different occasions to determine the changes in the coagulation time of the blood plasma and the number of blood platelets. In this series of nine experiments, the coagulation time was not significantly changed. It might, however, be stated more specifically that in two experiments there were no changes in the coagulation time of the blood plasma with ether anesthesia; in one experiment there was a slight increase while in the remaining experiments there were slight decreases. When the average figures for the nine experiments were considered there was an average decrease of 3 per cent in the coagulation time at the end of a half hour, an average decrease of 9 per cent at the end of an hour and an average decrease of 7.5 per cent at the end of four hours of anesthesia. The average normal control value was eighty-six seconds. In eight of nine experiments the number of blood platelets was increased. The average for the entire series was an increase of 78,000 blood platelets per cubic millimeter of blood.

Ether anesthesia caused a definite increase in the number of erythrocytes in the peripheral blood in a series of nine animals. After one hour of ether anesthesia, there was an increase of 18 per cent in the cell volume, 18 per cent in the value for the hemoglobin, and 15.5 per cent in the erythrocyte count. In contrast to ether anesthesia, sodium amytal anesthesia produced a decrease in the cell volume of 21 per cent, a decrease of 22 per cent in the value for the hemoglobin and a decrease of 19.7 per cent in the erythrocyte count. (Fig. 1.)

The marked change in the cellular constituents of the blood which was produced by ether anesthesia and sodium

amytal anesthesia occasioned a search for the mechanism involved. Accordingly, a group of experiments was carried out in an attempt to explain the part played by the spleen in altering the number of erythrocytes of the blood under ether anesthesia and sodium amytal anesthesia. Three animals, upon which determinations of the number of erythrocytes had been made previously, were splenectomized. Two weeks after splenectomy, studies were made on these animals with ether anesthesia and four weeks later with sodium amytal anesthesia. In addition, two dogs which had been splenectomized, one eight years, the other five years previously, were anesthetized first with ether and then with sodium amytal.

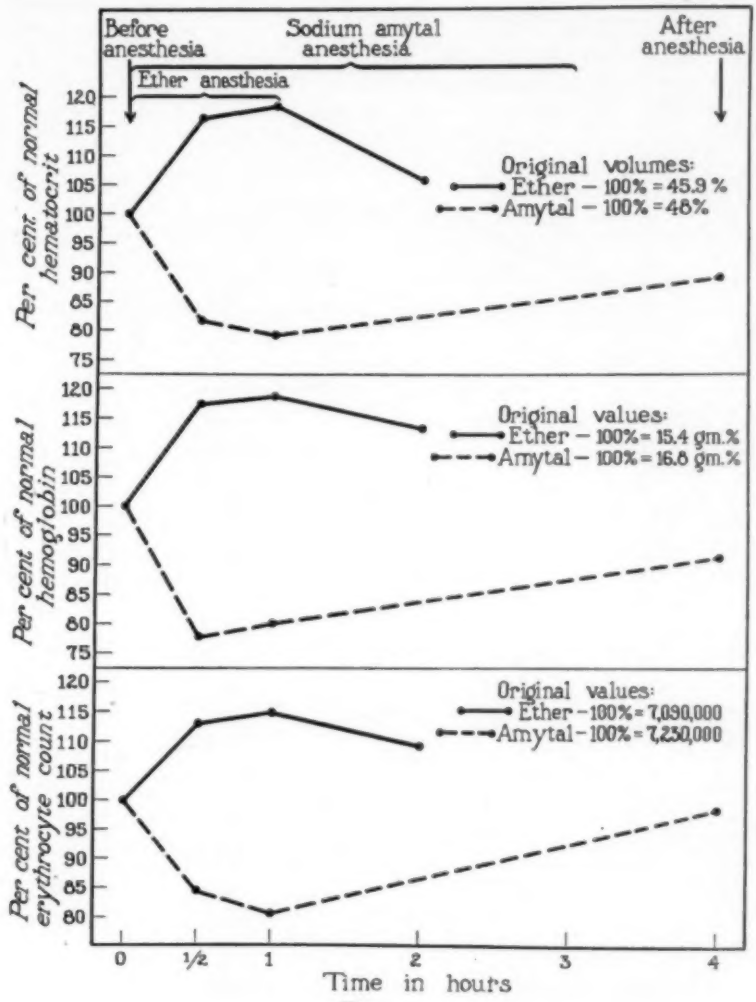


Fig. 1.

After removal of the spleen the values for cell volume, hemoglobin and the number of erythrocytes were increased, but the increases were about half as great as those obtained in the unsplenectomized animal under ether anesthesia. After splenectomy, the average increase in cell volume was only 7.6 per cent, the increase in the value for the hemoglobin was 12 per cent and the increase in the erythrocyte count was 11 per cent. (Fig. 2.) Splenectomy abolished completely the reduction of the erythrocytes of the blood which occurred in the normal intact animals under sodium amytal anesthesia. An average of the results obtained with splenectomized animals after one hour of sodium amytal anesthesia showed no change in cell

volume, a 6 per cent increase in the value for the hemoglobin, and a 4 per cent increase in the erythrocyte count. (Fig. 3.)

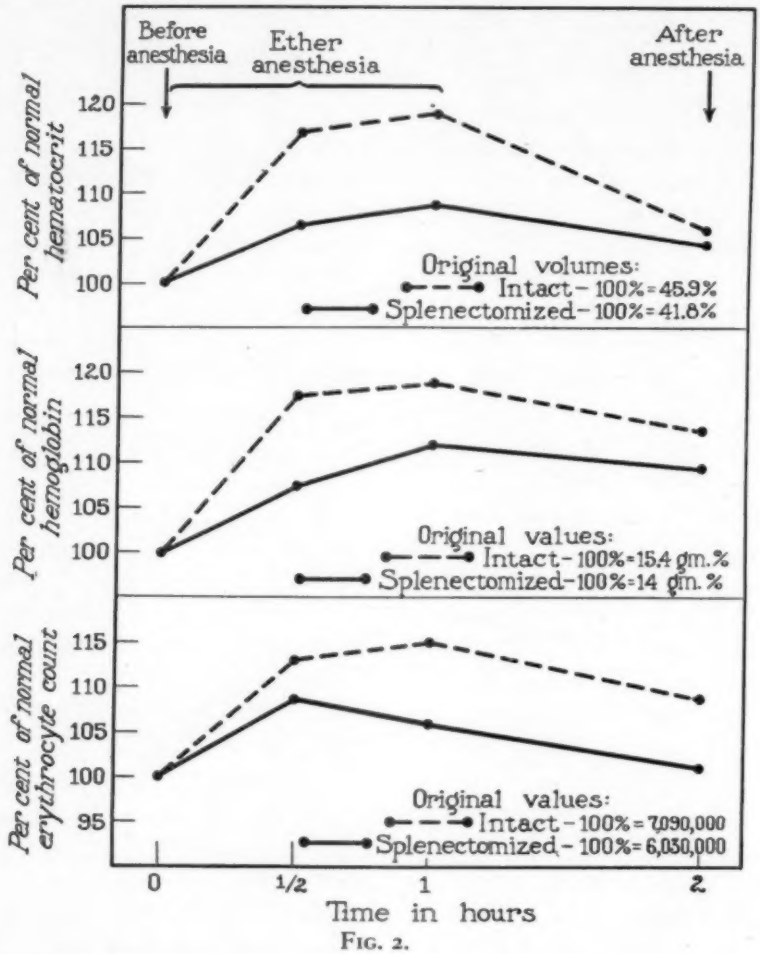


FIG. 2.

Similar observations were made on three animals in which the spleen had been previously denervated; changes in the number of erythrocytes of these animals were comparable to those in the normal intact animal.

COMMENT

Changes in the coagulation time of the blood plasma during ether anesthesia were slight, the average decrease being 9 per cent. It is doubtful whether so small a change is of significance. This decrease in coagulation time was less than the decrease of 15.2 per cent obtained by Mendenhall, who used whole blood. The increase in the platelet count with ether anesthesia parallels the increase in the erythrocyte count, the increase in the value for the hemoglobin and the increase in the cell volume. It is improbable that the increase in the number of blood platelets under ether anesthesia played any part in the slight decrease obtained in the coagulation time.

The majority of the more recent reports on changes in the blood produced by ether anesthesia have shown an increase in the cellular elements. The principal concern in this study has been to determine some of the factors which regulate this increase in the constituents of the blood of dogs under ether anesthesia. Contraction of the spleen has been frequently observed in animals under ether anesthesia. It has been shown that removal of the spleen reduced by half the increase in the erythrocytic findings which occurred with ether anesthesia in the normal intact animal. There-

fore, it appears probable that the greater concentration of blood obtained in the normal intact animal is due, to a considerable extent, to the contraction of the spleen, which forces the accumulated cells into the general circulation. The increase in the number of erythrocytes obtained with ether anesthesia in the splenectomized group of animals may be due to loss of fluids and a consequent concentration of erythrocytes.

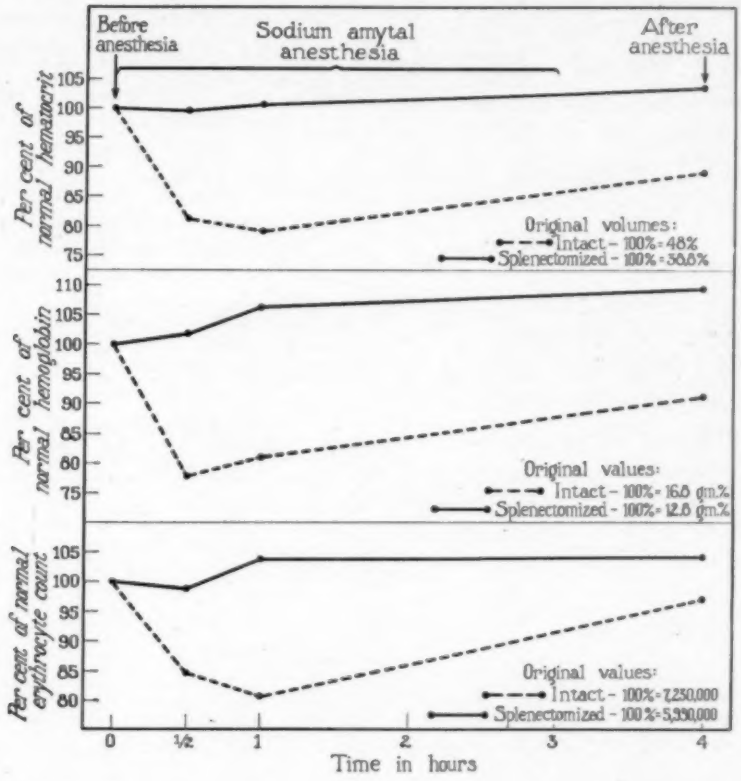


Fig. 3.

By means of experiments with sodium amytal and ether anesthesia on animals which had denervated spleens, it has been shown that alterations in the number of erythrocytes are not dependent on a nervous mechanism. Hargis and Mann showed that the splenic reflex was abolished by denervation of the spleen. In my study, ether given to three animals whose spleens had been denervated caused the same increases in blood concentrations as obtained in the normal intact animals.

The possibility that epinephrine might be responsible for the contraction of the spleen was not investigated. Emerson said that unequivocal evidence of the supposed action of ether on the adrenal glands is as yet lacking, but he firmly believed that ether anesthesia does stimulate the output of epinephrine.

The 20 per cent reduction in the number of erythrocytes of the peripheral blood, which was obtained in the normal intact animal with sodium amytal anesthesia, failed to occur in the same animals after splenectomy. I have observed that the spleen increases enormously in size under sodium amytal anesthesia. It therefore seems probable that the spleen in dilating removes the corpuscular elements from the general circulation, and by this mechanism causes a reduction in the number of circulating erythrocytes.

SUMMARY

The effects of ether anesthesia and sodium amytal anesthesia on the circulating erythrocytes and the coagulability of the blood plasma were investigated. The

coagulation time of the blood plasma under ether anesthesia was slightly, but probably not significantly, decreased. There was an increase in the blood platelet count during ether anesthesia. Ether anesthesia caused an increase in the cell volume, the value for the hemoglobin, and the number of erythrocytes. Removal of the spleen reduced, by a half, the increase in the cellular constituents which occurred in the normal intact animal during ether anesthesia. Sodium amytal anesthesia caused a decrease in the cell volume, the value for the hemoglobin and the number of erythrocytes. Splenectomy abolished completely the decrease in the cellular constituents which occurred in the normal intact animal during sodium amytal anesthesia.

I wish to thank Drs. Essex and Lundy for their help in the preparation of this paper.

REFERENCES

1. Adolph, E. F., and Gerbasi, M. J. Blood concentration under influences of amytal and urethane. *Am. J. Physiol.*, 106: 35–45 (Oct.) 1933.
2. Baldes, E. J., and Nygaard, K. K. Determination of the coagulability of the blood plasma by the photo-electric cell. *Proc. Staff Meet., Mayo Clin.*, 11: 151–155 (Mar. 4) 1936.
3. Barbour, H. G., and Bourne, Wesley. Heat regulation and water exchange. IV. The influence of ether in dogs. *Am. J. Physiol.*, 67: 399–410 (Jan.) 1924.
4. Bourne, Wesley. Blood concentration and body temperature in anaesthesia. *Brit. J. Anaes.*, 2: 36–39 (July) 1924.
5. Bourne, Wesley, Bruger, M., and Dreyer, N. B. The effects of sodium amytal on liver function; the rate of secretion and composition of the urine; the reaction, alkali reserve, and concentration of the blood; and the body temperature. *Surg., Gynec. & Obst.*, 51: 356–360 (Sept.) 1930.
6. Drabkin, D. L., and Edwards, D. J. The production of anhydremia with insulin. *Am. J. Physiol.*, 70: 273–282 (Oct.) 1924.
7. Emerson, G. A. Effects of various anesthesias on autoxidation rate of surviving brain tissue. *Proc. Soc. Exper. Biol. & Med.*, 33: 171–177 (Oct.) 1935.
8. Hamburger, W. W., and Ewing, F. E. The blood changes incident to surgical anesthesia. With special reference to those induced by nitrous oxid. A clinical and experimental study. *J. A. M. A.*, 51: 1586–1593 (Nov. 7) 1908.
9. Hargis, E. H., and Mann, F. C. A plethysmographic study of the changes in the volume of the spleen in the intact animal. *Am. J. Physiol.*, 75: 180–200 (Dec.) 1925.
10. Hardenbergh, J. G., and Mann, F. C. The autoinhalation method of anesthesia in canine surgery. *J. Am. Vet. M. A.*, 24: 493–501 (July) 1927.
11. Mendenhall, W. L. Factors affecting the coagulation time of blood. VII. The influence of certain anesthetics. *Am. J. Physiol.*, 38: 33–51 (July 1) 1915.
12. Nygaard, K. K. Coagulability of blood plasma. Remarks on the technic of its determination. *Proc. Staff Meet., Mayo Clin.*, 9: 151–156 (March 7) 1934.
13. Nygaard, K. K. A direct method of counting platelets in oxalated plasma. *Proc. Staff Meet., Mayo Clin.*, 8: 365–370 (June 14) 1933.
14. Sanford, A. H., and Sheard, Charles. The determination of hemoglobin with the photoelectrometer. *J. Lab. & Clin. Med.*, 15: 483–489 (Feb.) 1930.
15. Thomsen, Olof. A method for direct count of the blood plates in the blood. *Acta med. scandinav.*, 53: 507–516, 1920–1921.
16. Zopff, Gustav. Veränderung der thrombocytenzahl und der Gerinnungszeit des Blutes im Shock und verwandten Zuständen. *Ztschr. f. d. ges. exp. Med.*, 81: 534–542 (Jan. 15) 1932.

REPORT ON A NEW AND EFFECTIVE CAST MATERIAL

THOMAS H. PETERSON, M.D., F.A.C.S.

Junior Visiting Surgeon, Boston City Hospital; Assistant Orthopedic Surgeon, New England Medical Center; Assistant in Fractures, Harvard Medical School

BOSTON, MASSACHUSETTS

THIS paper proposes to present certain aspects in the development of a new and more effective material for immobilization of fractures and certain arthritic and muscular diseases which also necessitate immobilization.

For many years the surgeon has been using plaster of Paris in various forms. This, while efficient from the standpoint of immobilization, does not permit effective detailed *x*-ray penetration. Furthermore, casts of this type are extremely heavy and bulky. They are made of a material which softens when wet, is exceedingly dirty in application, and, when completed, they have a tendency to shed white powder over everything.

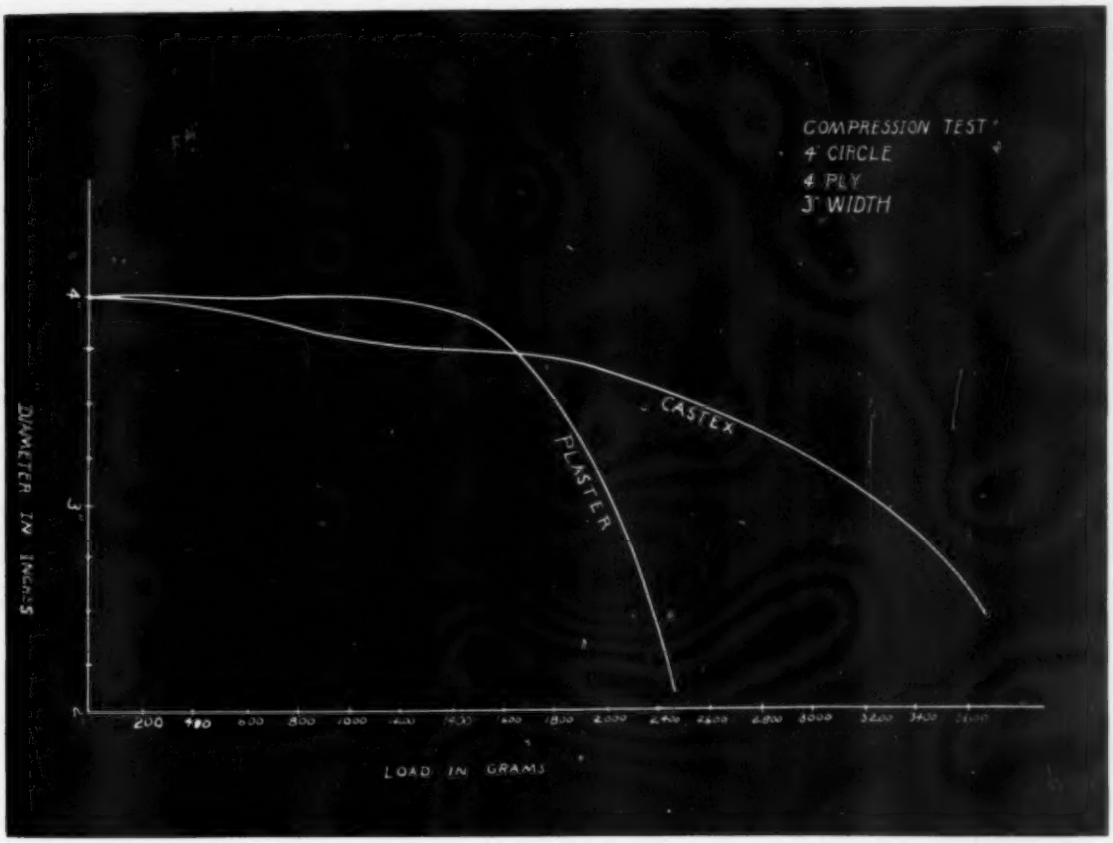


FIG. 1. Test 1.

A new material for the same purpose under the trade name of "Castex" has been used by the author for some four months with excellent success. It has been applied over fifty times on many different types of cases.

"Castex" is a bandage saturated with chemically pure acetone, coming in a sealed can ready for use. When the can is opened, setting or hardening of the collodion-like material begins at once. The

bandage, because of its compact weave, forms a brace or framework comparable to the steel structural work in a building. other hand, is a much more firmly woven material and holds within its texture the solvent which unites with the solvent in

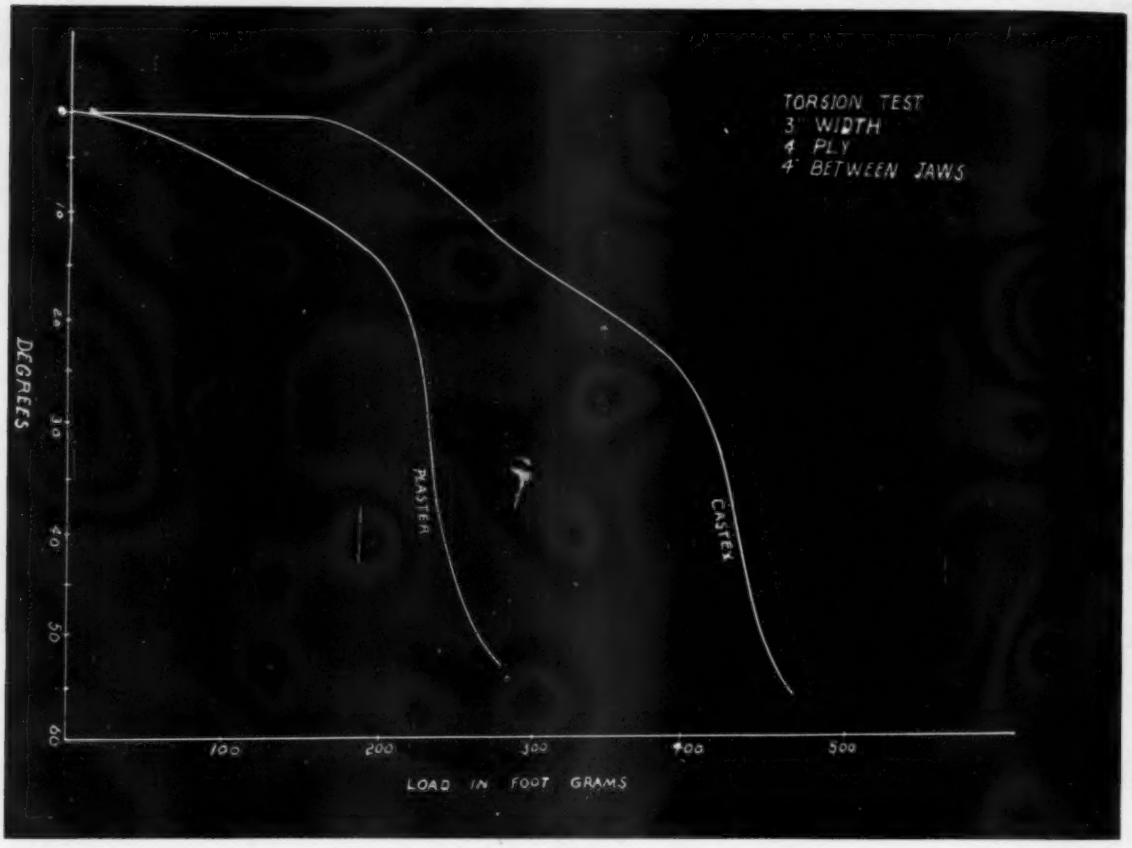


FIG. 2. Test II.

The solution gradually hardens into one solid mass, each layer of material being bound together by the cohesion of the solvent of adjacent layers as hardening occurs. Thus individual layers are automatically fused together over the site of application.

Since the method of hardening differs from that of plaster, it is worthy of discussion. In the ordinary plaster bandage solidification occurs as the result of evaporation and subsequent crystallization, thereby forming a solid mass of interlocking crystals. Because of the coarseness of the weave, the bandage itself plays little part in support, being only the medium by which the plaster is transported from a dry state to a wet state and eventually to a solid state. This new substance, on the the other layers of material as subsequent layers are applied to form, eventually, a solid cast. The hardening process is a little slower than in the case of regular plaster. It is also somewhat different in that the material hardens by the evaporation of acetone from the solvent. The exposed outer and the innermost layers of material harden first, followed later by the inside layers, which, because they are not equally exposed to evaporation, stiffen more slowly.

Because of the character of the material used in these new casts and because no opaque product is used, we find that we are able to expose the part to *x*-ray without increasing the penetration over the normal amount for an uncast limb. We can obtain perfect bone detail unobscured by casts,

which obviously is a great help. The surgeon thus has an opportunity to watch the bone's progress in repair.

to the fold of the thumb, weighed but 6 ounces. The new cast did the job more efficiently than did the moulded splint

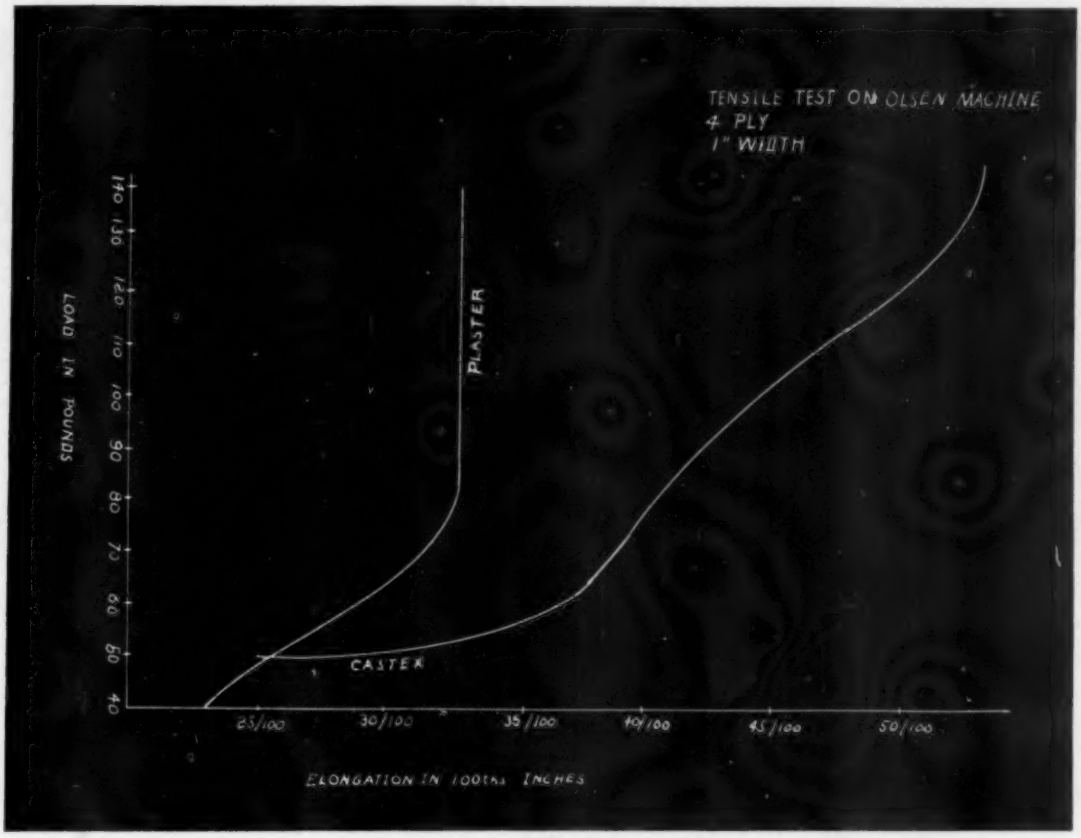


Fig. 3. Test III.

The firm, hardened cast is much thinner than the ordinary plaster cast. Ordinarily, three thicknesses of saturated gauze material are applied to the part, though in the more difficult fractures, more layers of material have been applied by the author (probably out of fright). These bandages are, therefore, much lighter than plaster could possibly be.

I recently had the opportunity to replace a posterior moulded splint made of plaster with a circular cast made of castex. The fracture was through the head of the radius without displacement. The posterior moulded plaster splint which was removed (without the bandage and sheet wadding which surrounded the arm) weighed 1 pound and 12 ounces while the circular castex which I applied for the same immobilization, from high on the humerus and weighed only one-third as much. Another example along the same line is that of a child who required a jacket in the correction of a scoliosis. The jacket which was removed weighed 13 pounds and the new cast, when cut, removed and weighed, was 1 pound and 12 ounces. This was about 15 per cent of the weight of ordinary material. A recently removed plaster cast from a fractured patella weighed 3 pounds 7 ounces and the new cast of castex but 1 pound (30 per cent as much).

The strength of these casts has been shown by tests to be actually greater than similar casts of greater thickness and material content. These tests vary, of course, according to the amount of material in the individual cast, but it is safe to say that comparable casts showed the strength to be four times greater than plaster and

the weight about 30 per cent that of the ordinary cast. The author, weighing about 190 pounds, has been able to stand on a back into place and may be closed snugly with a strap or a piece of adhesive tape. This procedure may be repeated success-

FIG. 4A. Case 1. *X*-ray of wrist before reduction.

FIG. 4B. Case 1. *X*-ray after reduction with new type of cast immobilizing fracture.

body cast, containing in its construction only five rolls of bandage, without crushing it.

It is interesting to note that hardened castex is remarkably resilient; so much so that we find it unnecessary to bivalve the cast. Instead, we split it, taking the limb out for inspection and then replacing it in the cast, which immediately springs fully several times. Such resilience is of great help in preserving the original shape of the cast.

Tests of the Product. In an effort to determine scientifically the actual difference in strength of the new material as compared to plaster of Paris 4 inch cylinders of 3 inch material, four thicknesses of each, were prepared.

Test I. (Fig. 1.) The compression test. This consists in clamping the two specimens in a machine. A dull knife edge is

Fig. 5. Case II. Fracture of external condyle of tibia in cast.

applied to the surface and weights are then applied. As the graph shows, destruction of the plaster cast occurred at 2,400 Gm. load. The new material, castex, was run up to the markings capacity without destruction. On removal from the machine the cylinder returned to its original shape.

Test II. (Fig. 2.) The torsion test. This shows the ability of material to twist, up to destruction or to maximum capacity of the machine. A 4 inch four-ply cylinder of plaster of Paris and of castex four were in turn inserted, and the torsion arm attached 1 foot from rigid or fixed point. Complete destruction of the plaster cast occurred at about 280 foot grams. The new material produced a deflexion of 60 with 480 foot grams (the capacity of the machine).

Test III. (Fig. 3.) Tensile strength (force necessary to tear the cast apart). It is interesting to note that no perceptible

Fig. 6. Case III. *X*-ray of arthritic hips through castex cast.

elongation occurred until a pull of 50 pounds was applied. It is further noteworthy that the new material has 50 per cent more stretch and will stand considerably more load before failure occurs.

Method of Care of Hands. In the application of casts I have for years been accustomed to applying them without gloves. This technique was tried with castex, but with bad results, as the necessary time taken to remove the solvent from the hands far exceeded that taken in applying the cast. Rubber gloves were found to be a successful solution to the problem. The hardened solvent was removed by rubbing the gloves between the hands after the solvent had hardened. It would then peel off in large flakes. Recently I have been wetting the hands first and then lathering with soap but not rinsing. After the cast has been applied the hardened solvent may easily be peeled off by washing the hands in water. Personally, I have had the unpleasant experience of having my hands become dry and scaly from ordinary plaster material. This

has not been true of the new material under discussion.

Preparation of the Leg. In preparing the leg for the application of the new type of plaster material there is little change in the technique of treatment. The usual stockinette is applied, followed by the usual number of layers of sheet cotton. Following this procedure it has been my custom to apply a layer of gauze to the limb, not so much for its effect in holding the sheet cotton in place as in its ability to promote evaporation of the solvent.

In a number of cases I have used two layers of stockinette only as padding and in several I have applied the stockinette over the layers of sheet cotton as well as in contact with the skin.

Method of Application. The castex is then applied in the usual manner. Care is taken, however, not to put torsion on the bandage as it is being applied. This caution is necessary as the material used in the bandage is cut on the bias and will stretch as well as contract. Rubbing the plaster material is helpful more to encourage conformation to the involved limb than to promote unification of the layers (so necessary in using ordinary plaster of Paris materials). Since hardening begins from within the cast, in most cases it is of sufficient strength in a short time so that the patient is unable to move the limb even though material itself is soft.

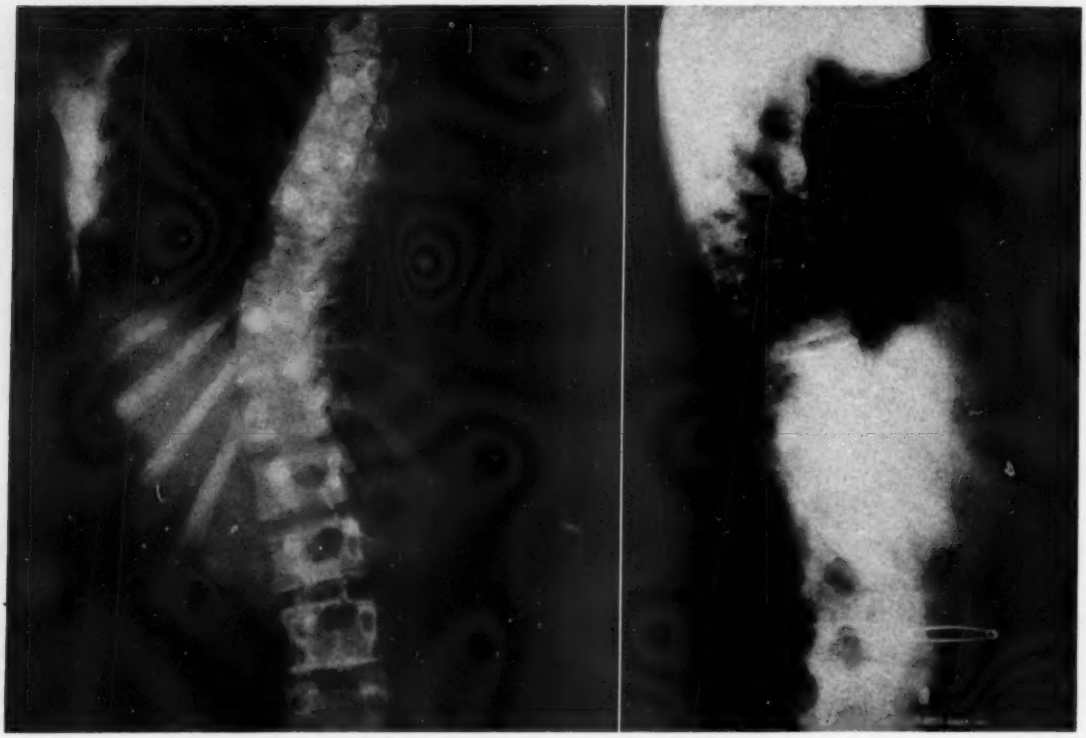


FIG. 7. Case IV. *X*-rays of scoliotic spine taken through cast of castex.

The hardening process is slower than with plaster of Paris, but this disadvantage is offset by the numerous advantages. The hardening time runs from eighteen to forty minutes for complete solidification. Dry hardness takes over two hours.

During the actual application of the cast the material is slightly inflammable and in this period it is advisable to have no open flame in the near vicinity. The combustibility of the material is far less than that of ether or collodion.

The following cases are among those treated with castex casts:

CASE I. W., a colored man, age 35, fell on the ice. There was immediate reduction of a reverse Colles' fracture, and a circular cast was applied to the wrist. Very little swelling was

noted and the patient was comfortable the next day with freely movable fingers. Because of the inability to control the actions of the patient, the cast was split on the following day, and he was discharged to the out-patient department. *X*-rays show the wrist before and after reduction. (Figs. 4A and B.) Note the excellent bone detail.

Case II. A young woman fractured the external condyle of the tibia. (Fig. 5.) This patient weighs 190 pounds and is 5 feet 4 inches tall. In this particular cast four 10-yard rolls of 3 inch castex were used. The cast weighed 1½ pounds as compared to the original cast which weighed 4 pounds 7 ounces. The patient therefore experienced much less difficulty in moving about.

Case III. Mrs. E., a woman of 69 years, suffered with a severe arthritis of the hip. (Fig. 6.) A walking spica cast was applied to immobilize the hip. In this case four cans of 3 inch castex were used and one can of 2 inch castex. The patient states that she is not bothered by the weight of the material.

Case IV. Miss D., age 15 years, had scoliosis first noted when she was three years of age. She has been constantly in casts since that time, and her condition, though somewhat improved, is still far from what one could wish. The present cast is made of castex, as was the previous one. *X*-rays show the present condition of the spine. (Fig. 7.) The castex cast which had been removed weighed 1 pound 14 ounces as compared to the preceding one constructed of plaster of Paris, which weighed 13 pounds.

These cases were selected from a group of over fifty in which the material has been used.

SUMMARY

"Castex" a new and effective cast material has the following advantages:

1. The material itself is 70 per cent lighter and four to five times stronger than plaster of Paris.
2. It has a remarkable resilience factor.
3. It is permeable to *x*-ray, and therefore allows for much better bone detail.
4. It is easy to apply.

THE MILLER-ABBOTT DOUBLE LUMEN TUBE IN INTESTINAL OBSTRUCTION*

A PRELIMINARY REPORT

ROBERT A. WISE, M.D.

Assistant Attending Surgeon, New York Hospital

NEW YORK CITY

THE treatment of intestinal obstruction, whether paralytic or mechanical has always been a difficult problem. The patients, often seriously ill from toxemia and dehydration, will not stand an exploration, and a simple enterostomy will often fail to alleviate the condition. Any new method which will aid in the treatment of these difficult cases should be welcome. Such a method is described and the results obtained have been so striking that an early acquaintance with its technique by those who undertake the treatment of these patients is desirable.

The method involves the use of a double lumen rubber tube, first devised by Dr. T. Grier Miller and Dr. W. Osler Abbott.[1,2] These men worked with the tube studying the secretion and absorption of the normal small intestine,[3,4,5,6,7,8,9] and with Dr. I. S. Ravdin first suggested its use in the treatment and diagnosis of cases of intestinal obstruction at the Joint Meeting of the New York Surgical Society and the Philadelphia Academy of Surgery in Philadelphia on February 9, 1938.[10] The use of the tube presents so many possibilities that it was tried in a series of cases, three of which are selected as a basis for this report.

DESCRIPTION OF TUBE

The Miller-Abbott tube is 10 feet in length and 16 French in diameter. A rubber septum extends throughout its length, making it into a double lumen tube. The inflation tube opens into a soft rubber balloon; the suction tube has several openings at its distal end and terminates in a metal tip. When the tube has passed the pylorus and the balloon is inflated, it will be carried, by peristalsis, down the entire length of the intestine. As it traverses the intestinal tract, suction is applied which removes fluid and gas from each distended loop. It is possible with this tube to deflate the entire gastrointestinal tract in patients with intestinal obstruction from whatever cause—mechanical or paralytic.

TECHNIQUE OF USE

The end of the tube is well lubricated with glycerin or K-Y and is passed through the nostril into the posterior pharynx. The patient is given a swallow of water and the tube readily passes into the stomach. It is introduced until the 75 cm. mark is reached. The patient is placed on his right side and this position is maintained for two to six hours, in which time the tip of the tube has usually passed through the pylorus into the duodenum. It is important to know whether the tube *has* passed into the duodenum. There are three aids in determining this: (1) The syringe test: an empty 30 c.c. glass syringe whose plunger moves in and out readily is used to inject 30 c.c. of air into the balloon. If the tube is in the duodenum the peristaltic action of the intestine will constrict the balloon and cause the plunger to be pushed back for a short distance. A minute later the plunger will be pushed back again by another peristaltic wave. If the tube remains in the stomach the plunger does not move or is pushed steadily back for its entire distance. (2) The character of the fluid coming from the suction tube is, at times, of material

* From the Surgical Service, Knickerbocker Hospital, New York.

assistance: the stomach contents are colorless, while the duodenal fluid is deeply bile tinged. Where obstruction has existed for several days, however, the contents of the stomach and duodenum will be identical in appearance. (3) *X*-ray is the most important aid. If the tube has passed into the duodenum a characteristic picture is seen.

Every effort should be made to get the tube into the duodenum by natural means, for it is often impossible to move a sick patient to the fluoroscope and manipulation with a distended abdomen is by no means easy. In some instances with the tube passed to the 75 cm. mark, it will be seen in the region of the pylorus with the tip turned back into the stomach. If the tube is then withdrawn to the 60 cm. mark and one inch added each fifteen minutes until the 75 cm. mark is reached, the tip will often enter the duodenum. If manipulation is necessary, this can be done with the aid of the fluoroscope, the left hand guiding the tip of the tube to the region of the pylorus and the right hand pushing it through.

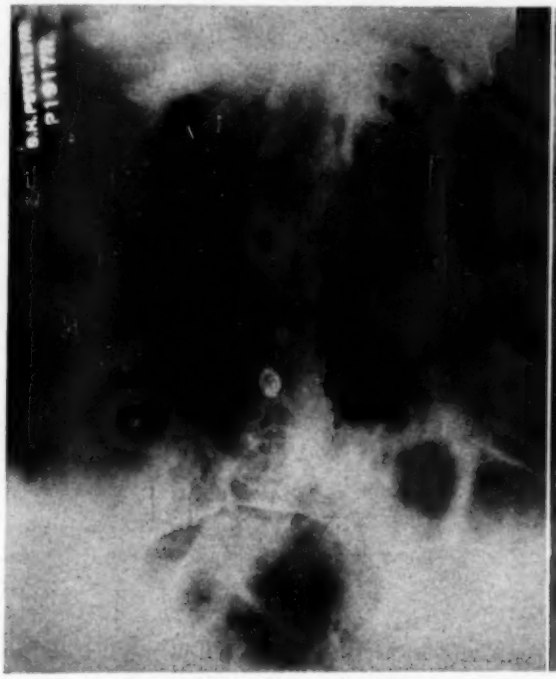


Fig. 1. Case 1. Flat plate of abdomen taken before insertion of tube, showing loops of distended small intestine.

Fig. 2. Tube far down in ileum twenty-four hours after passing the pylorus. Distention relieved.

Once the tube is in the duodenum, 30 c.c. of air is injected into the balloon, the balloon tube clamped and constant Wangansteen suction applied to the suction tube. Each hour 6 inches more of the tube is inserted until the 8 foot mark is reached. The suction tube is irrigated each hour with 20 c.c. of water.

Three cases are reported illustrating the use of the tube in: (1) paralytic ileus, (2) mechanical obstruction, and (3) as an aid in the diagnosis and location of an obstructive lesion in the small intestine.

CASE REPORTS

Case 1. H. J., a man of 54, was admitted to the Service of Dr. George A. Koenig at Bellevue Hospital, New York City on February 28, 1938. On the day of admission he had tripped and fallen down a flight of stairs. He complained of severe pain in his left thigh and inability to move his leg. *X*-ray examination revealed a comminuted fracture of the upper third of the left femur. The spine and pelvis were negative, heart not enlarged, lungs clear, the abdomen soft and not distended. There was a low, midline abdominal scar of a suprapubic cystotomy

done for bladder calculi in 1934. The urine was negative; the Wassermann, negative; W.B.C., 8,500, with 79 per cent polyps; N.P.N. 30.

Fig. 3. Case 1. Twenty-four hours after Figure 2. Tube has traversed the entire length of the small intestine and is in the cecum. Distention completely relieved.

The left leg was put up in Russell traction. Two days after admission, the patient complained of generalized abdominal pain and distention. His bowels did not move and he vomited several times. The abdominal distention increased in spite of high colonic irrigations, the Harris drip, abdominal stoops, pitressin, and the use of the Levin tube with Wangansteen suction. A flat plate of the abdomen (Fig. 1) revealed distended loops of small intestine.

On the fifth day after admission, the abdomen was markedly distended and tense. The abdominal skin was smooth and shiny, there was no point tenderness, and auscultation revealed a silent abdomen. He complained of constant lower abdominal pain and there had been no bowel movement during the five days. The temperature was 100.6; pulse, 110; respiration, 24.

The Miller-Abbott tube was passed and we encountered some difficulty in getting it through the pylorus, but once the fracture was disregarded and the patient placed on his right side, the tube entered the duodenum. The balloon was inflated and constant Wangansteen suction applied to the suction tube.

First Day. Twenty-four hours after the tube passed the pylorus, it was far down in the ileum. (Fig. 2.) The patient's condition was markedly improved: there was no abdominal pain, no vomiting, fluids were taken freely by mouth, and the abdomen was less distended. One thousand c.c. of fecal fluid had drained through the suction tube.

Second Day. The tube had passed through the entire small intestine and had entered the cecum. (Fig. 3.) Distention had subsided, the abdomen was soft, and the patient was able to take milk, cereal, and broth by mouth. He had a liquid bowel movement and the drainage from the tube was 900 c.c.

Third Day. The improvement continued. There was only slight abdominal distention and the patient was taking soft solids. The drainage was 480 c.c.

Fourth Day. The tube was clamped but left in place.

Fifth Day. The tube was removed through the nostril. There was no recurrence of his distention with the tube clamped and he had daily bowel movements.

After removal of the tube (two weeks ago), the patient remained well and had no further abdominal distention.

This was a case of paralytic ileus following a severe trauma. All usual measures to deflate the abdomen had failed and the patient's condition was becoming progressively worse. The relief afforded in this case by the tube was most rapid and within forty-eight hours the patient was cured of his ileus. Certainly no operative procedure could have accomplished this.

Case II. G. W., a man of 58, was admitted to the Knickerbocker Hospital on February 25, 1938, complaining of abdominal pain and distention of seven days' duration. The pain began in the region of the umbilicus and spread rapidly over the entire abdomen. The patient stopped work and remained at home in bed. He noticed his abdomen gradually increasing in size, and the pain, at first cramp-like in character, became constant. He vomited large quantities of bile tinged fluid daily; in spite of cathartics, his bowels had not moved for one week, and his abdomen became progres-

sively distended. Past history was essentially negative; the patient had had no operations and no similar attacks.

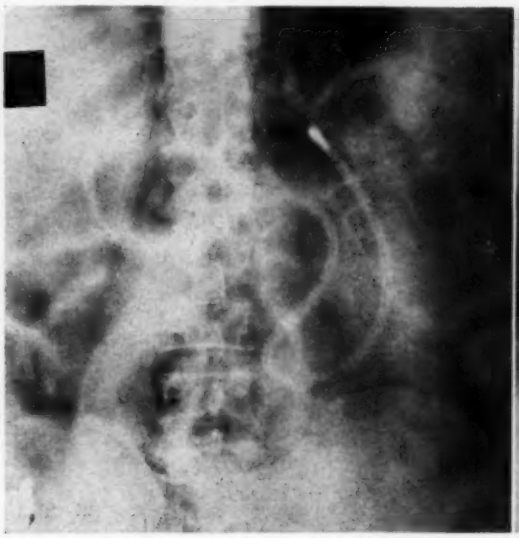


Fig. 4. Case 11. Tube in upper jejunum two hours after passing pylorus. Distended loops of small intestine are shown.

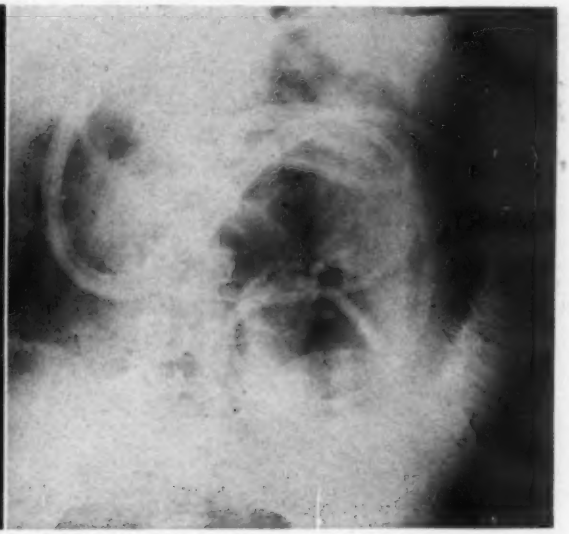


Fig. 5. Tip of tube in left lower quadrant stopped at point of obstruction. Injection of 50 c.c. of barium through tube, outlining distended loop of small intestine.

Admission examination revealed a very obese man, acutely ill. His temperature was 100; pulse, 92; W.B.C. 19,600, with 92 per cent polys. Lungs and heart were negative. The blood pressure was 180/100. The abdomen was markedly distended, tense and tympanitic, with no evidence of fluid, tenderness, or abnormal masses. There was a small umbilical hernia, 4 cm. in diameter which was not tender.

Because of the marked obesity and the uncertainty regarding what was causing the obstruction, conservative measures were tried. Enamata, high colonic irrigations, and a Levine tube with Wangansteen suction did not relieve the abdominal distention. Nothing was given by mouth and the patient received repeated infusions. He vomited 1,000 c.c. of fecal fluid on the second day.

The Miller-Abbott tube was introduced and within two hours passed into the duodenum. A flat plate taken at this time shows the tube in the upper jejunum about to enter a distended loop of the small intestine. (Fig. 4.) Constant Wangansteen suction was applied to the suction tube.

First Day. The abdomen was much softer, the patient was taking fluids by mouth and had no vomiting. The drainage was 3,000 c.c. of fecal fluid. An *x*-ray plate of the abdomen, taken after 50 c.c. of barium was injected through the suction tube, showed obstruction with a distended loop of small intestine proximal to it. (Fig. 5.) The tip of the tube had passed to the left lower quadrant. The barium was sucked out of the tube immediately after the *x*-ray was taken.

Second Day. The distention was further relieved and the patient was taking liquids and cereals by mouth. The drainage was 1,100 c.c.

Third Day. The tube remained in the same position in the left lower quadrant. The condition of the patient was excellent. The drainage was 1,700 c.c.

Fourth Day. The patient had a large spontaneous bowel movement. The abdominal distension was completely relieved. The drainage was 1,060 c.c. The tip of the tube was still in the left lower quadrant. The balloon was now deflated.

Fifth and Sixth Days. The tube was clamped for twelve hour periods. The patient was taking a soft solid diet with no return of distention and had daily bowel movements.

Seventh Day. The tube was clamped for twenty-four hours. The patient had no return of distention.

Eighth Day. The tube was removed. The patient was entirely well, and two days later was discharged from the hospital. He has since remained free from symptoms.

This patient had a partial mechanical obstruction of the small intestine which

rapidly became complete. The exact cause cannot be stated, but it was undoubtedly associated with the umbilical hernia. The

Fig. 6. Case III. Tube in upper jejunum two hours after passing pylorus. Injection of 50 c.c. of barium through tube was readily carried through loops of small intestine, showing no obstruction in this region.

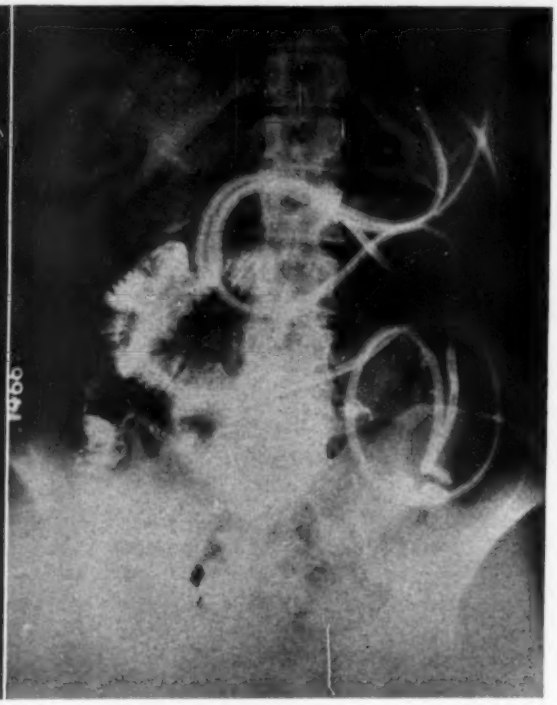


Fig. 7. Twenty-four hours later. Tip of tube has stopped at partial obstruction in lower ileum in the right lower quadrant. Injection of 50 c.c. of barium through tube showed kink in ileum.

distention was relieved and the obstruction disappeared. The benefit afforded by the tube in this case was miraculous; the abdominal pain subsided, the distention was relieved, and the patient took fluids and semi-solids within forty-eight hours.

Had the obstruction remained even after deflation of the abdomen, and operation been necessary, the tube would have been a great aid in locating the point of obstruction in this tremendous abdomen. For, although the balloon was kept inflated for four days, the tip of the tube never passed the left lower quadrant, the evident site of the obstruction.

Case III. M. H., a woman of 30 years, was admitted to the service of Dr. Frank McGowan at New York Hospital, February 19, 1938, complaining of repeated attacks of abdominal pain associated with nausea and vomiting. In 1924 she had had an appendectomy, in 1936 a partial right oöphorectomy with division of peritoneal adhesions. Seven days following the last operation, the patient developed acute intestinal obstruction due to a loop of small intestine being adherent to the posterior surface of the previous operative wound. This required a jejunostomy. Her convalescence was uneventful, and she remained well for one year. Two months before admission, the patient had a sudden attack of nausea and vomiting which occurred soon after eating and subdided in twenty-four hours. One month before admission, she had a similar attack associated with constant, dull aching pain in the lower abdomen. Four similar attacks followed this, one of which lasted five days. During attacks she had constant nausea and frequent vomiting. The bowels did not move and enemata and colonic irrigations were ineffectual. The last attack began three days before admission and was identical in character.

Physical examination was negative except for the abdomen which was slightly distended without rigidity or tenderness. There were four

well healed abdominal scars. The temperature was 98.6 degrees and the pulse 74. Hemoglobin was 90 per cent; R.B.C. 4,700,000; W.B.C. 5,200, with 55 per cent polys; urine negative. No *x*-ray evidence of intestinal obstruction was shown on admission.

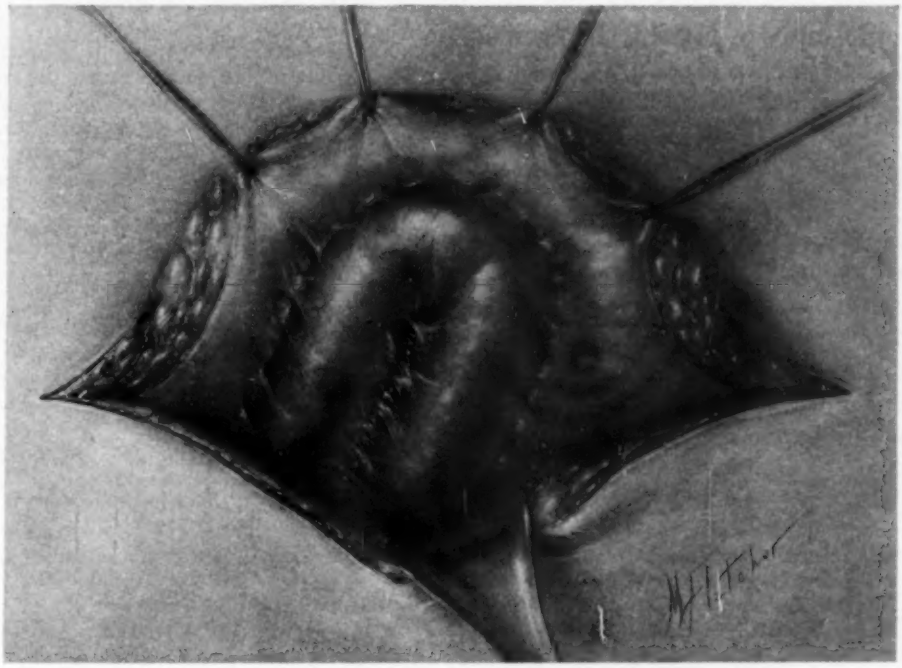


Fig. 8. Case III. Kink in ileum located in right lower quadrant.

Since, at previous operations, it had been shown that the patient was an adhesion former, it was believed that she had a partial intestinal obstruction due to peritoneal adhesions. The location of the obstruction, however, could not be determined. It was suspected to be in the jejunum at the site of the jejunostomy performed in 1936, especially because the vomiting occurred so promptly after eating and was not preceded by colic.

The Miller-Abbott tube was used to determine the nature and location of the obstruction. The tube was passed with some difficulty and it was necessary to manipulate it through the pylorus under the fluoroscope.

Two hours after the tip of the tube had passed the pylorus, the patient was taken to the fluoroscopic room and 50 c.c. of barium was injected through the suction tube. The barium passed readily through the upper jejunum, showing no obstruction in that region. (Fig. 6.)

Twenty-four hours later, after the tube was introduced to the 7-foot mark, a second fluoroscopic examination was made. At this time 50 c.c. of barium was injected through the suction tube as before and a very different picture was presented. The tip of the tube had stopped in the right lower quadrant and the barium advanced upward and then downward at an acute angle. An *x*-ray, taken at this time, showed an acute angulation of the ileum in the right lower quadrant. (Fig. 7.)

On February 24, 1938, under avertin-ethylene-oxygen anesthesia, an exploratory laparotomy through a low right rectus incision was performed by Dr. Frank McGowan. A loop of ileum was found firmly adherent to the parietal peritoneum in the right lower quadrant. The bowel was sharply kinked, causing a partial obstruction. (Fig. 8.) Other adhesions were present in the abdominal cavity but it was only in the right lower quadrant that the intestine was involved. The kinked loop of ileum was carefully dissected from the parietal peritoneum. The patient had a smooth convalescence and left the hospital on March 12, 1938.

It had been possible, using the tube, to locate the site of the obstructive lesion of the ileum.

SUMMARY

1. A new method of treatment of intestinal obstruction is reported.

2. The Miller-Abbott double lumen tube is described.

3. The technique of insertion of the tube is outlined.

4. The importance of placing the patient on his right side is emphasized.

5. Every effort should be made to have the tube enter the duodenum without manipulation.

6. If manipulation is necessary the fluoroscope is of aid.

7. Cases illustrating the use of the tube in the treatment of paralytic ileus and mechanical obstruction are reported.

8. The value of the tube in locating the site of a partial obstruction of the small intestine is demonstrated.

REFERENCES

1. Miller, T. G., and Abbott, W. O. Intestinal intubation; a practical technique. *Am. J. M. Sc.*, 187: 595–599, 1934.
2. Miller, T. G., and Abbott, W. O. Small intestinal intubation; experiences with a double-lumened tube. *Ann. Int. Med.*, 8: 85–92, 1934.
3. Abbott, W. O., and Miller, T. G. Intubation studies of the human small intestine. III. A technic for the collection of pure intestinal secretion and for the study of intestinal absorption. *J. A. M. A.*, 106: 16–18, 1936.
4. Karr, W. G., and Abbott, W. O. Intubation studies of the human small intestine. IV. Chemical characteristics of the intestinal contents in the fasting state and as influenced by the administration of acids, alkalies and of water. *J. Clin. Investigation*, 14: 893–900, 1935.
5. Abbott, W. O., and Pendergrass, E. P. Intubation studies of the human small intestine. V. The motor effects of single clinical doses of morphine sulphate in normal subjects. *Am. J. Roentgenol.*, 35: 289–299, 1936.
6. Miller, T. G., and Karr, W. G. Intubation studies of the human small intestine. VI. The influence of variations in the reaction and motility of the stomach contents on the reaction and the motility of the intestinal contents. *Am. J. Roentgenol.*, 35: 300–305, 1936.
7. Miller, T. G., Abbott, W. O., and Karr, W. G. Intubation studies of the human small intestine. VII. Factors concerned in absorption of glucose from the jejunum and ileum. *Am. J. Diges. Dis. & Nutrition*, pp. 742–753 (Jan.) 1937.
8. Miller, T. G., Abbott, W. O., and Karr, W. G. Intubation studies of the human small intestine. VII. Miscellaneous observations. *Am. J. Diges. Dis. & Nutrition*, pp. 647–650 (Nov.) 1936.
9. Miller, T. G. Intubation studies of the human small intestine. IX. Factors in the maintenance of physiological conditions. *Rev. Gastroenterol.*, pp. 115–120 (June) 1937.
10. Ravdin, I. S., and Abbott, W. O. A non-surgical method of treating, localizing and diagnosing the nature of obstructing lesions of the intestine. Joint Meeting of New York Surgical Society and Philadelphia Academy of Surgery, February 9, 1938.

THE EFFECT OF PERFORATION ON PEPTIC ULCER RESULTS

E. L. ELIASON, M.D. AND G. M. THIGPEN, M.D.

Professor of Surgery, School of Medicine, University of Pennsylvania

Assistant Instructor and Fellow in Surgery, University of Pennsylvania Hospital

PHILADELPHIA, PENNSYLVANIA

OPINIONS as to the proper operative treatment for perforated peptic ulcer, both gastric and duodenal, differ, and for many years various surgeons have used a number of methods in attacking this condition.

Mikulicz, in 1880, advocated simple closure of the perforation, but it was not until twelve years later (1892) that this was successfully performed and reported by Henssner. For some years following, oversewing of the perforation remained the procedure of choice and the majority of these patients, who recovered, remained entirely well. However, there was a definite group in each series of cases that suffered from persistent symptoms of mild to severe degree. Pyloric stenosis resulted in some of these, and relief was obtained by a secondary, or delayed, gastroenterostomy. In some clinics, Deaver's[1] for example, primary gastroenterostomy in conjunction with closure of the perforation was advocated in all cases, since it was hoped in this way to eliminate a second operation. With this more radical procedure, the results were not entirely satisfactory, since some patients were not relieved of symptoms.

Pool and Dineen,[2] reporting a series of fifty-nine cases of acute perforated ulcers of the stomach and duodenum, found that two out of three patients do well after simple closure of the perforation and that approximately one in three will require a secondary gastroenterostomy for pyloric obstruction. They were of the opinion that a definitely indicated late gastroenterostomy in one-third of the cases is preferable to subjecting all patients to a prophylactic gastroenterostomy at the time of the initial operation. Urrutia[3] found that simple closure gave satisfactory results in 63.6 per cent of twenty-two cases treated by this method, and on the contrary in 50 per cent of twelve cases that had had closure plus gastroenterostomy, marginal ulcers or later gastric or duodenal ulcers occurred, necessitating subsequent operation in four cases.

White and Patterson,[4] after an extensive review of the statistics of a number of writers, estimated that out of every 100 patients surviving the operation of simple closure of an acute perforation, approximately sixty to sixty-five will remain free of symptoms; approximately ten to fifteen will require further surgery, and of the remaining twenty-five, those who are reasonably careful about diet and general activity will get along well. This estimate is made up from reports of large series of cases by Gibson,[5] Williams and Walsh,[6] Pool,[2] Urrutia,[3] Johnston[7] and others. In their own series of cases, White and Patterson found that out of nineteen patients who had had simple closure and who were followed for an average period of five years, thirteen were entirely well. Of the six having persistent symptoms only two required further operative procedure. Only six patients having closure plus gastroenterostomy were followed and four of these were well. In their opinion, primary gastroenterostomy should be performed only if suture of the perforation causes obvious obstruction.

Shelley[8] carefully reviews the results in a series of eighty-two patients operated on for acute perforation of peptic ulcer and finds an operative mortality of 18.2 per cent. Simple closure was the procedure most frequently used, with 44 per cent of

the patients remaining well. The mortality in this group was 15.4 per cent. This method of treatment was used in all bad risks. Closure plus gastroenterostomy was performed next most frequently, with 61 per cent of the surviving patients being cured. The operative mortality in this group, however, was 23.3 per cent. Of the fifty-nine patients followed, eighteen had a recurrence of symptoms, necessitating subsequent operation in twelve. Follow-up and *x*-ray examinations were made in thirty-three cases, and the majority showed a permanent irregularity or filling defect at the site of the previous perforation. Only those having a return of symptoms showed hypermotility of the stomach, spasm, and tenderness to pressure at the point of the deformity. In Shelley's opinion, the least possible surgery should be done at the time of the original operation, which policy results in a much lower mortality rate. Additional operative procedures should be left for a later date and performed only when indicated. In case pyloric obstruction or stenosis is found at the original operation, he advocates passing a Levin tube into the stomach and guiding it past the pylorus into the duodenum. This will allow feeding until a time when the patient's condition permits a second operation.

Brenner[8] also found that simple closure gave better results than closure plus gastroenterostomy. Twenty-four patients, out of a series of forty-two, were followed from one to twenty years. Of these, eighteen had simple closure performed, with fourteen or 78 per cent, remaining well; while closure through gastroenterostomy was done in six instances, with only three patients remaining asymptomatic. In pus cases, subsequently operated on for other conditions, an opportunity was afforded to inspect the site of the former perforation, and in none was there any evidence of the previous ulcer, while the duodenum seemed entirely normal. He takes this to be highly presumptive evidence that perforation tends to cure the ulcer and that the duodenum is capable of complete restoration to normal, even though stenosis appears to be present at the time of closure.

In 227 cases of acute perforated gastric and duodenal ulcer, Shawan[10] reports a mortality of 24.22 per cent. The type of operative treatment employed was individualized in each case, but confined to the three procedures of simple closure, excision of the ulcer and closure, and closure with gastroenterostomy. The general policy followed was that the greater the risk presented at operation, the less was done. Simple closure was used entirely in the last 132 cases with a resulting 10 per cent reduction in mortality in this group.

Reperforation of a previously ruptured peptic ulcer, or subsequent perforation of ulcers through the one closed at the time of the original operation, is a rather infrequent occurrence, but many authors report such an event in a few of their cases followed for fairly long periods. Pearse,[11] in reviewing 4,183 cases of perforated peptic ulcer, found thirty-three patients with perforation, or an incidence of 0.69 per cent; twenty-four of these occurred in patients originally treated by simple closure, and eight in those having closure plus a primary gastroenterostomy. In one case the original method of treatment was not stated. Only one of the twenty-four cases treated by simple closure had more than two acute perforations, whereas five of the eight cases treated by closure with gastroenterostomy had three or more acute perforations with a jejunal ulcer being responsible in three patients. Two of the three deaths in the series of thirty-three reperforations occurred in the group that had had a previous gastroenterostomy added to the procedure of closure of the ulcer.

Guthrie and Sharer[12] conducted a careful follow-up study in fifty-seven cases recovering from operation for acute perforated duodenal ulcers. In their total series of seventy-eight cases, there was an operative mortality of 20.8 per cent in the

group having simple closures (sixty-eight cases) and a 50 per cent mortality in four cases having closure and primary gastroenterostomy. Of the fifty-five cases surviving simple closures, only ten patients required a secondary gastroenterostomy for recurrence of symptoms. Seven of these were completely cured, one has ulcer distress, one remained unrelieved and one died subsequently from cancer. The two patients recovering from primary gastroenterostomy are reported as well. It is their belief that simple closure of the perforation should be the procedure of choice in the majority of perforated duodenal ulcers, and that delayed gastroenterostomy may be safely performed later, if necessary.

Lewisohn[13] found that simple closure of an acute perforated peptic ulcer failed to cure the patient in 39 per cent of cases. He therefore raises the question as to whether a more radical procedure might not be advisable, but only in those cases coming to operation early, when the infection has not spread beyond the immediate vicinity of the ulcer.

Blackford and Baker,[14] from the results obtained in their series of twenty-one cases and from a partial review of the literature, advocate a primary gastroenterostomy in all cases where the patient is a good surgical risk.

Pyloroplasty of the Heineke-Mikulicz or Finney types has been advocated by some, but the results in the main are rather discouraging.

The tendency to more radical surgery in the treatment of acute perforations of peptic ulcer in the central European clinics and especially in Germany, is well emphasized by Graves[15] in his analysis of 4,402 cases from these clinics. Partial gastrectomy in all good risks is the generally accepted procedure, since it has been found that multiple gastric or duodenal ulcers occur in an average of 30 per cent of patients operated on for an acute perforation. If the so-called "ulcer-bearing area" was not removed, there was a fairly high percentage of recurrence of symptoms due to the presence of the remaining ulcers. The mortality in 775 cases so treated was only 18.2 per cent in the better operative risks. Simple closure and closure plus gastroenterostomy were reserved for the poor risks with a mortality of 50 per cent and 13.8 per cent respectively. Lewisohn[13] feels that every patient who has had one of the more conservative primary operative procedures and who still has marked symptoms after six to eight months should be subjected to a partial or subtotal gastrectomy.

With this diversity of opinion concerning the treatment of choice in cases of perforated peptic ulcer, it seems that only through continued study of the end results, and especially permanency of cure, in patients treated by the various methods will a satisfactory answer to the problem be obtained. It was for this reason that the present study was undertaken.

This series comprises seventy cases of ruptured peptic ulcer admitted to Surgical Service C and to the former service of Dr. George Muller previously a member of the surgical staff of the Hospital of the University of Pennsylvania over a period of fourteen years—from 1922 to 1936. There were fourteen perforations of gastric ulcers compared to fifty-six duodenal perforations, or a frequency of one to four.

In the gastric group there were twelve males, ranging in age from 21 to 55 years with an average age of 42 years, and two females, aged 49 and 67 years—average 58 years. Contrary to the opinion of Blackford and Baker,[14] all gave a previous history of ulcer of from three months to fifteen or more years, except two, who had had symptoms for only two weeks.

Of the fourteen cases, eleven were acute perforations, and three were classed as subacute, the interval between the time of perforation and time of operation in the latter group being from three to five days. This time interval was found to be a most important factor in all cases in the immediate operative mortality.

In the eleven acute cases, simple closure of the perforation was the method of treatment in six instances, drainage being employed in four cases; in two the abdomen was closed without drainage. In each of these two the time interval was quite short, (less than six hours) and there was no general peritoneal soiling. Both had an uneventful convalescence. Four patients in this group recovered and two died, the cause of death being bronchopneumonia in one and cardiac failure in the other. This gave an operative mortality of 33.33 per cent in this group.

Closure of the perforation plus primary gastroenterostomy was performed in five cases, all but one being drained; in that one the time interval was only five hours and the general peritoneal cavity was clean. There were no deaths in this group. In the acute group, a total of nine patients recovered and two died, an operative mortality of 18.18 per cent.

In the three cases of subacute perforation, two were found, at operation, to have definite abscess formation, and the procedure consisted simply of draining the abscess cavity. Both recovered, one complicated by fistula formation which eventually closed. In one case in which the ulcer could not be oversewed because of edema and induration, and where gastroenterostomy was impossible because of dense adhesions, a jejunostomy with drainage was done because of obstruction. This patient died on the fourth postoperative day from peritonitis and bronchopneumonia. This one death gives an operative mortality of 33.33 per cent in the subacute perforated group.

Of a total of fourteen cases of perforated gastric ulcer, there were eleven recoveries and three deaths, or an operative mortality of 21.43 per cent. (Table 1.)

In the 56 cases of duodenal perforation there were fifty-four males, ranging in age from 19 to 68 years, with an average of 41 years, and two females, aged 31 and 77 years, an average of 54 years. All but eleven gave an ulcer history of from three or four months' to twenty years' duration. Of these eleven there were five with symptoms for only two weeks, two with symptoms for only one week; one with symptoms for only four days, and three with no previous symptoms whatsoever. They had been in perfect health until the time of the acute catastrophe.

TABLE 1
THE MORTALITY IN PERFORATED GASTRIC ULCERS

	Cases	Lived	Died	Per Cent Mortality
Acute perforation				
Simple closure	6	4	2	33.33
Closure and gastroenterostomy	5	5	0	0
	11	9	2	18.18
Subacute perforation				
Drainage only	2	2	0	0
Jejunostomy	1	0	1	100
	3	2	1	33.33
Total	14	11	3	21.43

Of the fifty-six cases, forty were of the acute perforated type, and sixteen were classed as subacute, the time interval being from two or three days to as long as two weeks before operation. Here again the elapsed time from perforation to operation was most important.

In the treatment of the acute perforations, simple closure was performed in twenty-two cases, drainage being employed in all but two cases. In these two the time interval was less than six hours and there was no widespread contamination of the peritoneum. Both recovered without complications. Twenty patients recovered, there being but two deaths, one from peritonitis and one from peritonitis and bronchopneumonia, an operative mortality of 9.09 per cent.

Closure of the perforation plus primary gastroenterostomy was performed seventeen times, drainage being employed in all but one case, regardless of the time interval

between perforation and operation. In this instance the patient died on the third postoperative day as a result of lobar pneumonia. Post-mortem examination showed no evidence of spreading peritoneal infection. Twelve patients survived operation and five died (an operative mortality of 29.41 per cent). The causes of death in these five cases were: peritonitis and bronchopneumonia, two; peritonitis, one; lobar pneumonia, one; and pulmonary embolism, one. The other patient with an acute perforation of a duodenal ulcer was operated on eighteen and one-half hours after onset of symptoms and with signs of acute intestinal obstruction. The small intestine was found greatly distended and an enterostomy was done in an attempt to relieve the obstruction. From the appearance of the peritoneal cavity at operation, the possibility of a ruptured peptic ulcer was suggested, but the patient was too ill to allow any further procedure and it was hoped that the process would become walled off. However, death occurred twenty-four hours postoperatively and a perforated duodenal ulcer and generalized peritonitis were found at autopsy.

With this fatality, there was a total of eight deaths in the acute perforated group, or a mortality of 20 per cent.

In the subacute group comprising sixteen cases, the method of treatment varied, depending on the findings at operation. Drainage only of a localized abscess was performed in three instances, with two deaths, one from cardiac failure and one from peritonitis; closure of the perforation was done in two, with one death from heart-block, the patient dying on the operating table. Closure of the perforation and gastroenterostomy were performed in seven, with one death from peritonitis, septicemia and bronchopneumonia; gastroenterostomy in three, in which the perforation and surrounding inflammatory process was well walled off, with no deaths. In one case, a partial gastrectomy was done by the Polya method, with a jejuno-jejunostomy. This patient was found to have three duodenal ulcers, one of which had perforated. This was the only instance of multiple ulcers in the entire series. The patient recovered.

Table II
MORTALITY IN PERFORATED DUODENAL ULCERS

	Cases	Lived	Died	Per Cent Mortality
Acute perforation				
Simple closure	22	20	2	9.09
Closure plus gastroenterostomy	17	12	5	29.04
Enterostomy	1	0	1	100.00
	40	32	8	20.00
Subacute perforation				
Drainage only	3	1	2	66.66
Closure plus gastroenterostomy	7	6	1	14.28
Simple closure	2	1	1	33.33
Gastroenterostomy	3	3	0	0
Polya resection and jejuno-jejunostomy	1	1	0	0
	16	12	4	25.00
Total	56	44	12	21.43

There were four fatalities in the subacute duodenal group, a mortality of 25 per cent.

Table III
MORTALITY IN SEVENTY CASES OF RUPTURED PEPTIC ULCER

	Cases	Lived	Died	Per Cent Mortality
Perforated gastric ulcer (acute and subacute)	14	11	3	21.43
Perforated duodenal ulcer (acute and subacute)	56	44	12	21.43
Total	70	55	15	21.43

In the fifty-six cases of perforated duodenal ulcer, there were twelve deaths, giving a mortality of 25 per cent. (Table II.)

In the entire series of seventy cases there were fifteen deaths, giving a mortality

of 21.43 per cent—the same as that in each of the two groups. (Table III.) Table IV shows the causes of death in the fifteen cases given.

TABLE IV
CAUSES OF DEATH IN FIFTEEN CASES

Peritonitis	4
Peritonitis and bronchopneumonia	4
Cardiac failure	2
Bronchopneumonia	1
Lobar pneumonia	1
Pulmonary embolism	1
Peritonitis, septicemia and bronchopneumonia	1
Heart-block	1
	15

Follow-Up Study. Of the fifty-five patients who recovered from their operations, forty-seven have been followed and many have had subsequent roentgenologic examinations. Nine could not be followed for more than six months to one year, twenty-eight were followed for from one to five years, and ten for more than five years. The results of this follow-up study are shown in Table V.

In the cases of perforated gastric ulcer, three of the patients who had had simple closures are well, and one, who was troubled with persistent ulcer distress, suffered a second perforation a year after the original operation, necessitating a second closure: at the same time, a gastroenterostomy was done. This patient has been well since. Four of the five having closure of the perforation plus primary gastroenterostomy remained well and one complained of mild ulcer symptoms which could be controlled entirely by diet.

In the cases of acute perforated duodenal ulcer, eighteen of the twenty-one having simple closure of the perforation were followed. Twelve were completely relieved of all symptoms after the original operation, two were improved, their mild symptoms being controlled by diet, and in four there was persistent ulcer distress. One of these suffered a second perforation three and one-half years after the first operation, requiring a second closure with gastroenterostomy. The patient recovered and has remained well since, although some dietary restriction is necessary. Two patients required a secondary gastroenterostomy for symptoms of pyloric obstruction, six months and three years, respectively, after simple closure. Both of these have had no further symptoms. The fourth patient with persistent severe symptoms showed *x*-ray evidence of a recurrent ulcer two years after operation. At the present time, three years after operation, he is unrelieved by diet and alkali powders but refuses further surgery.

Of the eighteen patients with acute duodenal perforation who had closure plus a primary gastroenterostomy, sixteen have been followed, ten for from one to five years, and six for more than five years. Twelve of these have had no further symptoms and four are reported as improved. However, in two of these four, *x*-ray examination three years and seven years after operation has shown probable evidence of the occurrence of a jejunal ulcer. All four have been fairly comfortable following a restricted diet.

In the subacute duodenal perforation, all three of those patients having gastroenterostomy have been followed for one to five years. One has had no further symptoms and the other two suffer only mild distress after meals, controlled by diet. One of these two showed *x*-ray evidence of a jejunal ulcer two years after operation. The patient who had had a Polya resection and jejuno-jejunostomy because of multiple duodenal ulcers (one of which was the site of a subacute perforation) has been followed for five years, and although improved, must adhere to a fairly strict diet with frequent feedings to remain comfortable. During the last year there have been two brief episodes of gastrointestinal hemorrhage with dark blood in the stools, which is presumptive evidence of another peptic or marginal ulcer.

A comparison of the results of the two most frequently employed procedures, simple closure of the perforation and

closure plus primary gastroenterostomy is given in Table VI.

Including the four cases of simple closure in which a secondary gastroenterostomy was performed, this method resulted in nineteen patients out of twenty-two

TABLE V

FOLLOW-UP RESULTS IN PERFORATED PEPTIC ULCER

Type of Operation	Lived	Cases Followed	Length of Follow-up			Results			
			6 Mo.–1 Yr.	1–5 Yr.	Over 5 Yrs.	Well	Imp.	Unimp.	Secondary Op.
Gastric ulcers									
Simple closure	4	4	1	3	..	3	..	1	1
Closure plus gastroenterostomy	5	5	2	2	1	4	1		
Drainage only (subacute cases)	2	0							
Duodenal ulcers									
Simple closure	21	18	6	9	3	12	2	4	3
Closure plus gastroenterostomy	18	16	..	10	6	12	4		
Gastroenterostomy (subacute cases)	3	3	..	3	..	1	2		
Polya resection and jejunostomy (subacute case)	1	1	..	1	..	..	1		
Drainage only (subacute case)	1	0							
Total	55	47	9	28	10	32	10	5	4

being cured, or a percentage of 86.4. The method of closure plus primary gastroenterostomy resulted in sixteen out of twenty-one patients being cured, or a percentage of 76.2. To offset this lower percentage of cures in the second group is the fact that in no case was a secondary operation necessary.

While the end results obtained by these two methods are not greatly different in this series, it would seem, considering the higher mortality in the group having closure plus primary gastroenterostomy that simple closure alone at the time of the original operation should be the method of choice, unless the patients come to operation early, i.e., within the first six hours. In that case, a primary gastroenterostomy should be done only if the closure of the perforation results in obvious pyloric or duodenal obstruction, and if the patient's condition is sufficiently satisfactory to permit the additional time necessary for the second procedure.

TABLE VI

COMPARATIVE RESULTS IN SIMPLE CLOSURE AND CLOSURE PLUS GASTROENTEROSTOMY

	Lived	Cases Followed	Well	Imp.	Unimp. after First Op.	Secondary Op.	Well after 2nd Op.	Per Cent Well
Simple closure	25	22	15	2	5	4	4	86.4
Closure plus gastroenterostomy	22	21	16	5	0	0	0	76.2

SUMMARY AND CONCLUSIONS

1. A review of seventy cases of perforated peptic ulcer is presented with

emphasis on the permanence of cure following perforation.

2. The usually reported relative frequency of perforated duodenal to perforated gastric ulcer is found, with a far greater majority occurring in males.

3. The mortality in the gastric and duodenal group is exactly the same—21.43 per cent.

4. Simple closure of the perforation results in a lower mortality than does closure plus a primary gastroenterostomy.

5. In cases of subacute perforation the operative procedure should be altered according to the conditions found in each particular case.

6. In the patients having simple closure at the time of the original operation, four secondary operations were necessary, two for reperforation and two for pyloric obstruction; while in the group having closure plus primary gastroenterostomy, no subsequent operations were necessary, but two developed a jejunal ulcer.

7. Final end results in twenty-two cases of simple closure, including four with secondary operations, show a somewhat higher percentage of permanent cures (86.4 per cent) than in twenty-one cases of closure plus primary gastroenterostomy (76.2 per cent).

REFERENCES

1. Deaver, J. B., and Pfeiffer, D. B. Gastroenterostomy in acute perforating ulcer of the stomach and duodenum. *Ann. Surg.*, 73: 73; 441, 1921.
2. Pool, E. H., and Dineen, P. A. Late results of gastroenterostomy and gastric and duodenal ulcers, including acute perforated ulcers. *Ann. Surg.*, 76: 457, 1922.
3. Urrutia, Luis. Late results in perforated gastroduodenal ulcers. *Ann. Surg.*, 90: 73, 1929.
4. White, W. C., and Patterson, H. A. Late results of simple suture in acute perforation of duodenal ulcers. *Ann. Surg.*, 94: 242, 1931.
5. Gibson, C. L. Acute perforations of stomach and duodenum. *Am. J. M. Sc.*, 165: 809, 1923.
6. Williams, H., and Walsh, C. H. Treatment of perforated peptic ulcer. *Lancet*, 228: 9, 1930.
7. Johnston, L. Acute perforation of gastric and duodenal ulcers. *Internat. Clin.*, 365: 145, 1926.
8. Shelley, H. J. Perforated peptic ulcer—a statistical and roentgenological study. *Am. J. Surg.*, 15: 227, 1932.
9. Brenner, E. C. Perforated ulcers of the duodenum. *Ann. Surg.*, 102: 185 (Aug.) 1935.
10. Shawan, H. K. Acute perforated gastric and duodenal ulcers. *Ann. Surg.*, 98: 210, 1933.
11. Pearse, H. E., Jr. Recurrent perforation of peptic ulcer. *Ann. Surg.*, 96: 192, 1932.
12. Guthrie, D., and Sharer, R. E. Permanence of cure following ruptured duodenal ulcers. *J. A. M. A.*, 107: 1018 (Sept. 26) 1936.
13. Lewisohn, R. Late results in perforated gastroduodenal ulcers. *Ann. Surg.*, 87: 855, 1928.
14. Blackford, J. M., and Baker, J. W. Acute perforated peptic ulcer. *Am. J. Surg.*, 13: 18, 1931.
15. Graves, Amos M. Perforated peptic ulcer in German clinics. *Ann. Surg.*, 98: 197, 1933.

PERFORATED PEPTIC ULCER*

AN ANALYSIS OF 100 CASES

LAWRENCE S. FALLIS, M.D., F.R.C.S.

Division of General Surgery, Henry Ford Hospital

DETROIT, MICHIGAN

THE material for this compilation was obtained from the case records of 100 consecutive operations for perforated peptic ulcer performed at the Henry Ford Hospital from June 1917, to December 1936, approximately a twenty year period. The primary objective of this study was to consider the clinical factors which have a direct bearing on the mortality rate and to assess the various operative procedures. It is presented solely for its statistical value.

TABLE I
SEX

Sex	No. of Patients	Percentage
Males	97	97
Females	3	3
	100	100

Sex. The usual ratio of peptic ulcer is one female to three male patients. The catastrophe of perforation, however, rarely occurs in the female, and the preponderance of males, 97 per cent in this series, is in accordance with the reports of other observers. A satisfactory explanation of this great variance has not been made. It may be that the laborious nature of the occupations of the male in general accounts for the increased tendency of their peptic ulcers to perforate. The influence of this factor is substantiated by European authors who report a much higher percentage of perforations in females than occurs in this country. The majority of clinic patients in European countries is drawn from the peasant class whose women do not enjoy the same immunity from hard labor as their American sisters.

TABLE II
AGE

Decade	Age	No. of Patients	Percentage
1.	0–9	0	0
2.	10–19	3	3
3.	20–29	8	8
4.	30–39	36	36
5.	40–49	36	36
6.	50–59	14	14
7.	60–69	3	3
		100	100

Age. The youngest patient in the series was aged 18 and the oldest 67 years. The greatest number of perforations, 72 per cent, occurred in the fourth and fifth decades, between the ages of 30 and 50. The influence of occupation is again suggested, since the patients in this large group are at the height of their physical activity. The number of cases, 53 per cent, occurring after the age of 40 is surprising in view of the prevalence of carcinoma in this age group.

TABLE III
OCCUPATION

Type of Work	No. of Patients	Percentage
Hard labor	75	75
Sedentary	25	25
Total	100	100

* From the Department of Surgery, Henry Ford Hospital, Detroit, Michigan.

Occupation. The influence of occupation on perforation is suggested in Table III where it is shown that 75 per cent of the patients were engaged in occupations that entailed heavy lifting and straining. This relationship of perforation to physical stress has been commented upon by various European authors. They attribute the occurrence to the fact that the European laboring classes eat coarser food and indulge in beer drinking to a greater extent than those whose work is of a sedentary nature. These differences in food habits do not compare with the case of the American workman whose standard of living and consumption of beer varies but little from those in the so-called white collar group. Some other explanation, such as increased intra-abdominal pressure, may be the determining factor.

TABLE IV
SEASONAL INCIDENCE

Season	No. of Patients	Percentage
Winter {December (8), January (4), February (3)}	15	15
Spring {March (9), April (10), May (6)}	25	25
Summer {June (15), July (7), August (11)}	33	33
Fall {September (10), October (8), November (9)}	27	27
Total	100	100

A definite seasonal variation in the number of perforations is shown in Table IV. The summer season, with 33 per cent of the perforations, showed more than double the incidence of the winter season, 15 per cent. The greatest number of perforations occurred in June—15 per cent—a figure that equalled the entire winter season; and the smallest number occurred in January and February, 3 and 4 per cent respectively. The low incidence of perforation occurring during the winter months and the high incidence during the summer months indicates the influence of diet on perforation of peptic ulcer. In winter, food is more concentrated and the amount of fluids is restricted, while in the summer months bulky meals predominate owing to increased consumption of vegetables and fruit, and the volume of fluid intake is greatly augmented.

Alcohol. No generalization regarding the effect of the regular use of alcohol on perforation can be made from this series, from here only 14 per cent were habitual consumers of alcohol, though most European authors note an increased incidence of perforated ulcers in beer drinkers. The peptic ulcer of one patient in this group perforated during a beer-drinking bout, but in this instance the purely mechanical influence cannot be discounted.

Tobacco. The facts regarding the use of tobacco are too meager to evalute, but it is significant that only 15 per cent of the patients were non-smokers.

Trauma. The decision of the compensation boards establishing a relationship between trauma and perforation has received general acceptance and has settled controversy on the subject. The influence of trauma is definitely established in 4 per cent of our patients. Perforation came on immediately after abdominal injury in two patients and occurred in two instances during the course of a fluoroscopic examination of the stomach after the ingestion of a barium meal.

TABLE V
DURATION OF ULCER SYMPTOMS BEFORE PERFORATION

Length of History	No. of Patients	Percentage
No history	11	11
1–6 months	18	18
6 months–1 year	4	4
1–2 years	18	18
2–5 years	18	18
5 years plus	27	27
Not recorded	4	4
Total	100	100

Duration of Ulcer Symptoms before Perforation. The relatively few patients, 11 per cent, who gave no history suggestive of ulcer previous to perforations is at variance with the commonly accepted view on the subject, but is in accordance with the reports of recent careful observers. The largest number of perforations, 27 per cent according to the classification in Table v, occurred in the group of patients whose ulcer symptoms had been present five years or more. This observation emphasizes the potential danger of long untreated peptic ulcer.

Table VI
PREVIOUS DIAGNOSIS OF ULCER

	No. of Patients	Percentage
Undiagnosed	44	44
Definite clinical diagnosis	28	28
Ulcer suspected	24	24
X-ray diagnosis	0	0
Not recorded	4	4
Total	100	100

Previous Diagnosis of Ulcer. Although in 44 per cent of the patients a diagnosis of ulcer had not been made, only 11 per cent of the total patients gave a history negative for ulcer. A definite clinical diagnosis had been made in only 28 per cent of the patients, and *x*-ray corroboration had not been obtained in a single instance. All this group had been subjected to intensive ulcer treatment. In 24 per cent of the patients, peptic ulcer had been suspected at one time or another by their medical attendant but they had not been under a definite regime of ulcer therapy.

Activity at Time of Perforation. In the largest group, 36.4 per cent, perforation came on while the individual was at work. This again draws attention to the influence of occupation on perforation. However, the accident does occur even when the victim is not active, for 27 per cent of the patients were resting at home. Undoubtedly some of this latter group were resting because of the onset of prodromal symptoms which not infrequently herald the impending disaster. Table VII also shows that perforation occurs even when activity is reduced to a minimum, for 9.5 per cent of the patients were in bed at home and 8.1 per cent were in the hospital. In two of the six patients whose perforations occurred in the hospital, the onset was coincident with a Roentgen examination after a barium meal. The inference here is that the trauma associated with fluoroscopic examination was the determining factor. There is an old adage to the effect that the most dangerous place for an ulcer to perforate is in the hospital.

Table VII
ACTIVITY AT TIME OF PERFORATION

	No. of Patients	Percentage
At work	27	36.4
Resting at home	20	27.0
In bed at home	7	9.5
In hospital	6	8.1
Walking	6	8.1
After drinking water	4	5.4
Driving automobile	2	2.7
Hunting	1	1.4
Drinking beer	1	1.4
Total recorded	74	100.0
Unrecorded	26	
Total	100	100.0

Table VIII
TEMPERATURE

Temperature	No. of Patients	Percentage
96°F.– 97°F	8	10.3
97°F.– 98°F	17	21.8
98°F.– 99°F	18	23.1
99°F.–100°F	21	26.9
100°F.–101°F	9	11.5
101°F.–102°F	2	2.6
102°F.–103°F	3	3.8
Total recorded	78	100.0
Unrecorded	22	
Total	100	100.0

Our experience bears out the truth of this contention, for death occurred in three of the six patients where perforations occurred in the hospital, a mortality rate of 50.0 per cent. The influence of the purely mechanical factor of distention is also brought out in Table VII, where it is shown that perforation came on in four instances after drinking water and on one occasion after drinking beer.

Temperature. A rise in temperature does not necessarily accompany the perforation of a peptic ulcer. A subnormal temperature was observed in 32.1 per cent of the patients in this series and in 55.2 per cent the temperature did not exceed 99°F. A rise in temperature above 100°F. was noted in only 17.9 per cent of the patients.

TABLE IX
PULSE RATE

Rate per Minute	No. of Patients	Percentage
60– 70	2	2.6
70– 80	11	14.1
80– 90	10	12.8
90–100	20	25.6
100–100	14	17.9
110–120	17	21.8
120 plus	4	5.2
Total recorded	78	100.0
Not recorded	22	
Total	100	100.0

Pulse Rate. In the early stages of perforation the pulse rate is often not increased. Table IX shows that in 16.7 per cent of the patients the pulse rate was under 80 beats per minute and in 55.1 per cent it was under 100.

Leucocytosis. Perforation creates an early and in most instances a high leucocytic response. The leucocytic count was under 10,000 in only 11 per cent, and was greater than 20,000 in 16.1 per cent of the patients. There was a leucocytosis of over 15,000 in 48.2 per cent or almost one-half of the total patients.

TABLE X
LEUCOCYTOSIS

Reading	No. of Patients	Percentage
Under 8,000	5	6.2
8,000–10,000	4	4.9
10,000–12,000	12	14.8
12,000–15,000	21	25.9
15,000–20,000	26	32.1
20,000–plus	13	16.1
Total recorded	81	100.0
Not recorded	19	
Total	100	100.0

TABLE XI
POLYMORPHONUCLEAR LEUCOCYTE COUNT

Percentage of Polymorphonuclears	No. of Patients	Percentage
60– 70	2	2.8
70– 80	14	19.7
80– 90	35	49.3
90–100	20	28.2
Total recorded	71	100.0
Not recorded	29	
Total	100	100.0

Polymorphonuclear Leucocyte Count. The percentage of polymorphonuclear leucocytes was increased in most instances in proportion with the total white cell increase. Table XI shows that the polymorphonuclear leucocytes were under 70 per cent in only 2.8 per cent of the patients and were over 80 per cent in 77.5 per cent of the patients.

Location of Intensity of the Pain in Perforation. In addition to the general character of the abdominal pain, the distress is intensified in certain areas. Table XII brings out the point. Localization, as is to be expected, was most common in the epigastrium, 77.5 per cent, and in a total of 82.4 per cent of the patients the severity of the pain was above the umbilicus. The remaining small groups presented diagnostic problems in some instances because

Table XII
LOCATION OF INTENSITY OF THE PAIN IN PERFORATION

	No. of Patients	Percentage
Epigastric	66	72.5
Right upper quadrant	6	6.6
Right lower quadrant	6	6.6
Umbilical	5	5.5
Left upper quadrant	3	3.3
Back	3	3.3
Right shoulder	2	2.2
Total recorded	91	100.0
Not recorded	9	
Total patients	100	100.0

the maximum point of tenderness was not in the upper abdomen. The tendency of excess peritoneal fluid to track down along the right paracolic gutter to the pelvis is indicated by localization of the pain in the right upper quadrant in six instances with a preoperative diagnosis of acute cholecystitis being made in two patients, and localization in the right lower quadrant on six occasions with a precoperative diagnosis of acute appendicitis in three patients. Evidence of subdiaphragmatic irritation was presented by the two patients who complained of pain in the right shoulder.

Table XIII
DIAGNOSIS OF PERFORATION

Diagnosis	No. of Patients	Percentage
Perforated peptic ulcer	88	88
Ruptured appendix with general peritonitis	4	4
Ruptured abdominal viscera	3	3
Appendicitis, acute	3	3
Cholecystitis, acute	2	2
	100	100

Diganosis of Perforation. Perforated peptic ulcer is the most easily diagnosed of all abdominal emergencies. A correct impression may be gained, in most instances, from the history of a sudden onset of severe agonizing abdominal pain plus the finding of abdominal rigidity. The abdominal muscle spasm in our series was generalized in 86.7 per cent of the patients and restricted to the right rectus muscle in 13.3 per cent. Certain of the classical textbook signs of perforations were present in only a limited number of patients; for example, shock was observed in only 26 per cent, knee flexion in 21 per cent, and obliteration of liver dulness in only 5 per cent. A correct diagnosis was made in 88 per cent of our cases, as shown in Table XIII. In the remaining twelve patients, the preoperative diagnosis indicated the necessity for immediate laparotomy and hence the diagnostic error was not of great importance.

Table XIV
ANESTHETICS

Agent	No. of Patients	Percentage	Deaths	Percentage
Ethylene and ether	43	43	9	20.9
Spinal: alone	32	41 (alone 1; plus ethylene 2)	3	4.9
Spinal: plus ethylene	9			
Ether	11		5	45.5
Ethylene	4	4	3	75.0
Total general	58	58	17	29.3
Local	1	1	1	100.0

Anesthetics. The record of spinal anesthetic as illustrated in Table XIV is striking, for of the thirty-two patients on whom this agent was used alone there was only one death, a mortality rate of 3.1 per cent, and in the nine additional patients on whom it was found necessary to supplement the spinal anesthesia with ethylene there was only one death. Thus there were only two deaths in the forty-one patients to whom spinal anesthesia was administered, giving a total mortality rate for spinal anesthesia of 4.9 per cent.

General anesthesia was used in a total of fifty-eight patients with seventeen deaths, giving a mortality rate of 29.3 per cent. Thus on comparison it is found that the mortality following the use of general anesthesia is six times that of spinal anes-

thesia. The contrast does not yield a true picture, since spinal anesthesia was used in only the later cases in the series, when other factors, such as the routine use of the continuous gastric suction tube, blood transfusion, and the oxygen, tent, have been of material value in reducing the mortality rate. However, even after discounting the benefits that have occurred from improved postoperative treatment and the possible erroneous inferences that may have been drawn from consideration of a small series such as this, the vastly superior results obtained in the cases in which spinal anesthesia was used merit the continuance of its use. The one patient whose operation was performed under local anesthesia was in such a serious condition that the use of either general or spinal anesthesia was contraindicated.

Incisions Employed. A right rectus incision was used in 61 per cent of the patients and a midline incision through the linea alba in 39 per cent. The latter incision has the advantage of reducing the operating time because there is less bleeding and both the opening and the closing are less time-consuming. Furthermore, if wound infection occurs, as it did in 13 per cent of our cases, there is less chance of tissue loss, since the fascial spaces are not opened. The general indictment against the midline incision is not borne out in this series since all six cases of wound disruption occurred in right rectus incisions, and postoperative ventral hernia occurred in three patients who had a right rectus incision and in three who had a midline incision.

Character of the Peritoneal Fluid. Table xv shows that the intra-abdominal fluid in this series of perforations was clear in only 2.1 per cent of the cases. This suggests that aspiration would be of value in cases of doubtful diagnosis. In one-third of the cases the peritoneal fluid presented a turbid flocculent appearance due to fibrin. Definite gastric contents, usually residue from the previous meal, were found in 17.2 per cent. The finding of blood-stained fluid in 3.2 per cent of the cases indicates that occasionally a blood vessel is eroded during the process of perforation.

Culture of the Abdominal Fluid. A bacteriologic examination of the abdominal fluid obtained at operation was made in thirty-six cases. A positive culture was obtained in twelve of these, 33.3 per cent, and in twenty-four instances 66 per cent, the culture was negative. Staphylococcus, streptococcus, both hemolytic and non hemolytic, and B. coli, alone and in various combinations, were the organisms encountered. The mortality in the patients with a positive culture was double the rate for the series as a whole. Death occurred in five of the twelve cases, a mortality rate of 41.7 per cent.

Table xv
CHARACTER OF THE PERITONEAL FLUID

	No. of Patients	Percentage
Containing fibrin	30	32.3
Gastric contents	16	17.2
Mucous	15	16.2
Mucopurulent	12	12.9
Bile-stained	10	10.8
Blood-stained	3	3.2
Purulent	3	3.2
Brownish	2	2.1
Clear watery	2	2.1
Total recorded	93	100.0
Not recorded	7	
Total	100	100.0

Table xvi
LOCATION OF THE ULCER

Site	No. of Patients	Percentage	Deaths	Percentage
Pylorus	44	44	5	11.4
Duodenum	33	33	10	30.3
Anterior gastric wall	15	15	0	00.0
Lesser curvature	6	6	4	66.7
Posterior gastric wall	2	2	1	50.0
Total	100	100	20	

Location of the Ulcer. Obliteration of the pyloric veins occurs so frequently in

perforation that positive identification of ulcers in juxtaposition to the pylorus is extremely difficult. This state of affairs has led to the adoption of an extra classification of ulcers designated as pyloric, a group that in this series accounted for a total of 44 per cent of the cases. The probability is that most of this group rightfully belong with the duodenal ulcers. If the pyloric ulcers are included with the duodenal ulcers, it is shown in Table xvi that the mortality for gastric and duodenal ulcers is approximately the same, since there were seventy-seven duodenal ulcers with fifteen deaths, a mortality rate of 19.5 per cent, and twenty-three gastric ulcers with five deaths, a mortality rate of 21.3 per cent. The high mortality rate, 30.3 per cent, of the frankly duodenal ulcers, when compared with the fifteen perforated ulcers in the anterior gastric wall, suggests that the technical difference in making a satisfactory closure may have a bearing on the mortality rate. The ease with which a perforation on the anterior gastric wall can be infolded and the difficulties in performing an effective closure of an indurated duodenal wall are too well known to require comment.

Table xvii
operative procedures

Operation		No. of Patients	Percentage	Deaths	Percentage
Closure plus omentum	68				
Simple closure	15				
Total closure	..	83	83	15	18.1
Closure plus gastroenterostomy	10				
Excision plus pyloroplasty	2				
Excision plus gastroenterostomy	1				
Excision	1				
Total gastric operations	..	14	14	2	14.3
Closure plus jejunostomy	..	2	2	2	100.0
Closure plus cholecystectomy	..	1	1	1	100.0
Total	..	100	100	20	20.0

Operative Procedures. The performance of gastric surgery at the time of perforation is well illustrated in Table xvii. The finding of a mortality rate of 18.1 per cent for closure and the slightly better rate of 14.3 per cent for the cases in which additional gastric surgery was performed is in accordance with the observation of Blackford and Baker in their extensive review of the published statistics. In making this comparison due consideration must be taken of the fact that gastric surgery was undertaken only in the best risk patients.

Our present-day practice is to be content with simple closure of the perforation. This is emphasized by our records, which show that in the last thirty-five cases of this series there was not a single gastroenterostomy performed. The most frequent indication given for gastroenterostomy is the fear of pyloric obstruction. However, in practice the possibility of obstruction is not great since it occurred only twice out of the eighty-three cases treated by closure alone: in one instance, a gastroenterostomy for the relief of pyloric obstruction had to be performed on the twelfth postoperative day, and in an another, one month after operation for closure. The successful outcome of both these operations may have been due to their being carried out as planned rather than emergency procedures. Granting that, in experienced hands and in patients whose general condition is good, the addition of a gastroenterostomy does not add to the mortality rate, nevertheless, it is our impression that simple closure of the perforation is the operation of choice and that obstruction, if it does develop, can be more safely relieved at a second operation.

Drains. The location of the drains and their possible influence on mortality is set forth in Table xviii without revealing any facts of value, largely because the series is so small. It is our practice at the Henry Ford Hospital to drain all cases where there

TABLE XVIII
DRAINS

Location	No. of Patients	Percentage	Deaths	Mort. Percentage
Ulcer site	28	28	9	32.2
Kidney pouch and pelvis	21	21	4	19.0
Kidney pouch	17	17	0	0.0
Ulcer site, kidney pouch and pelvis	16	16	3	18.7
Ulcer site and pelvis	12	12	1	8.3
Ulcer site and kidney pouch	5	5	3	60.0
No drainage	1	1	0	0.0
Total	100	100	20	

TABLE XIX
CAUSES OF DEATH

	No. of Patients	Percentage
Peritonitis	9	45
Shock	2	10
In extremis	1	5
Anesthetic	1	5
Pulmonary collapse	1	5
Pneumonia	1	5
Empyema	1	5
Duodenal fistula	1	5
Acute pancreatitis	1	5
Abdominal abscess	1	5
Subphrenic abscess	1	5
Total	20	100

is soiling of the peritoneal cavity. The principal cause of death after operation for perforated ulcer is peritonitis. It seems reasonable to assume, therefore, that drainage in some instances at least might prevent this complication, in spite of the fact that the value of drains in preventing peritonitis is till controversial. It has been established that while the contents of the stomach and duodenum may be sterile, a certain proportion contains pathogenic organisms capable of producing peritonitis.

Soft rubber cigarette drains inserted through a stab wound at the outer border of the right rectus muscle to the right kidney pouch will provide adequate drainage for the upper abdominal cavity, and if there is soiling or excess fluid in the pelvis as revealed by the suction tube, a suprapubic stab wound is made and a cigarette drain introduced through it into the pelvic cavity. We have not attributed complications or sequelae arising in any of the cases in this series to the use of drains, and it has been our impression that in some instances their use was a life-saving measure.

Causes of Death. Table XIX shows that there was a total of twenty deaths in the 100 patients operated upon for perforated peptic ulcer, giving a mortality rate of 20 per cent. One of the fatalities was purely an anesthetic death. It was occasioned by an overdose of ethylene in a patient whose general condition was excellent and presumably would have recovered. Another death occurred in a patient whose condition was so precarious that operation had to be performed under local anesthesia. It is risks like these that swell the mortality rate. Peritonitis is the greatest hazard to recovery, accounting in this series for 45 per cent of the fatal issues. Pulmonary complications were given as the cause of death in 15 per cent of the patients. The life of the patient who died from a duodenal fistula might have been saved if a more radical operation had been performed; when it was realized that induration around the perforation prevented adequate closure, too much faith was placed in the ability of omental tags to close the defect. A posterior gastroenterostomy plus pyloric occlu-

TABLE XX
RELATION OF TIME OF OPERATION TO MORTALITY RATE

Time of Operation	Total Cases	Deaths	Percentage
0–6 hours	47	3	6.4
6–12 hours	28	6	21.4
12–18 hours	7	3	42.8
18–24 hours	3	2	56.7
24 hours plus	7	5	71.4
Not recorded	8	1	
Total	100	20	

sion would have given the patient a better chance.

Relation of Time of Operation to Mortality Rate. The greatest single factor favoring recovery after a perforated peptic ulcer is prompt surgical intervention. This point is well brought out in Table xx. In our series there were only three deaths in the forty-seven patients who were operated upon within six hours of perforation, giving a mortality rate of 6.4 per cent or just one-third of the mortality rate for the series as a whole. The death rate mounted rapidly with each succeeding six hour period, and after twenty-four hours reached the appalling rate of 71.4 per cent.

Table xxi
mortality

Period	No. of Patients	Deaths	Per cent Mortality
1917–1926	16	10	62.5
1927–1936	84	10	11.9
Total	100	20	20.0

Mortality. As indicated in Table xxi, the results of operation for perforated peptic ulcer have shown a tremendous improvement in recent years. The mortality rate for the first ten years of this series was 62.5 per cent, and for the second ten year period, it decreased to 11.9 per cent. The last nineteen operations of this series have all been successful. Earlier operation and improved preoperative and postoperative treatment are the factors responsible for bringing about this reduction in mortality. They are both indices of surgical progress. That patients with perforated peptic ulcers are now seen earlier is emphasized by the observation that during the first ten year period of the series, only 50 per cent of the patients were operated upon within twelve hours of perforation as compared with 80 per cent in the second ten year period and that operation was delayed twenty-four hours or more in 25 per cent of the patients in the first group, but in only 3.7 per cent in the second group. This simply reflects the improved training of the present day medical practitioner.

In our experience such measures as the preoperative administration of intravenous fluids, spinal anesthesia, routine blood transfusions, and the continuous gastric suction have played a major rôle in saving the lives of victims of this serious abdominal emergency. We feel that the preoperative and postoperative management of the patient is of greater importance than the experience of the operating surgeon, an opinion that is substantiated by noting that the majority of the patients in the first group were operated upon by members of the permanent surgical staff and that the majority of the patients in the second group were operated upon by the resident surgeons.

Table xxii
length of stay in hospital

	No. of Patients	Percentage
14 days	3	3.7
14–21 days	48	60.0
21–28 days	15	18.7
Over one month	14	17.5
Total patients recovered	80	

Length of Stay in Hospital. An indication of the period of disability following recovery from an emergency operation for perforated peptic ulcer is given in Table xxii. Here it is shown that of the eighty patients who recovered, only 3.7 per cent were able to leave the hospital on the fourteenth postoperative day, and only a total of fifty-one patients, or 63.7 per cent, were home at the end of the third week. The seriousness of the condition is further emphasized by the fact that fourteen patients, or 17.5 per cent of the series, spent more than one month in the hospital following operation.

Follow-up. Our follow-up was inadequate because the majority of the patients were drawn from the shifting industrial

elements of the population. We were able to trace only 69 per cent of our patients over periods varying from six months to ten years. Persistence or recurrence of ulcer symptoms was found in twenty-five of these patients, or 36.3 per cent of those traced, an observation that is in keeping with the recent investigation of Sallick, but is not in accordance with the commonly accepted view.

SUMMARY

1. One hundred consecutive cases of perforated peptic ulcer operated on at the Henry Ford Hospital during the twenty year period from 1917 to 1936, are analyzed.

2. The mortality rate was 20 per cent for the whole series, but was only 11.9 per cent during the last ten years.

3. The improved results are due to better postoperative treatment, including the routine use of blood transfusions and gastric suction.

4. Spinal anesthesia was also a definite factor in reducing the mortality rate.

5. Gastroenterostomy and other gastric operations were performed on 14 per cent of the patients with a mortality rate of 14.3 per cent, while the mortality rate for simple closure was 18.1 per cent. In spite of these figures simple closure is recommended.

6. Drainage was employed in all but one case. The use of drains is advocated because peritonitis is the chief cause of death after perforation.

The author wishes to express his thanks to Dr. Henry P. Koehler for his assistance in the preparation of this material.

REFERENCES

Blackford, J. M., and Baker, J. W. Acute perforating peptic ulcer; report of 21 cases with review of 933 cases reported by 13 authors during last 10 years. *Am. J. Surg.*, 12: 18 (April) 1931.

Corff, M. Acute perforated peptic ulcer; review of 63 cases. *Am. J. Surg.*, 24: 77 (April) 1934.

Eliason, E. L., and Ebeling, W. W. Catastrophes of peptic ulcer. *Am. J. Surg.*, 24: 63 (April) 1934.

Gerhardt, F. Erfahrungen bei der Behandlung perforierter Ulcera ventriculi et duodeni an der I. Chirurgischen Universitatsklinik in Wien in den Jahren 1919 bis 1933. *Wien. klin. Wchnschr.*, 49: 1389 (Nov. 13) 1936.

Graham, R. R. Treatment of perforated duodenal ulcers. *Surg., Gynec. & Obst.*, 64: 235 (Feb.) 1937.

Graves, A. M. Perforated peptic ulcer in German clinics; analysis of 4,402 cases. *Ann. Surg.*, 98: 197–209 (Aug.) 1933.

Held, I. W., and Goldbloom, A. A. Perforated peptic ulcer. *Med. Clin. North America*, 17: 1279 (March) 1934.

Lang, H. J. Über den Durchbruch von Magen- und Zwölffingerdarmgeschwüren in die freie Bauchhöhle: Erfahrungen and Beobachtungen an 152 Fällen. *Beitr. z. klin. Chir.*, 162: 143, 1935.

Moynihan, B. Perforation of gastric and duodenal ulcer. *Practitioner*, 120: 137 (March) 1928.

Sallick, M. A. Late results in acute perforated peptic ulcer treated by simple closure. *Ann. Surg.*, 104: 853 (November) 1936.

Shawan, H. K. Acute perforated peptic ulcer; summary of 211 cases of acute perforated gastric and duodenal ulcers. *J. Michigan Med. Soc.*, 33: 434 (Aug.) 1934.

Trout, H. H. Treatment of perforated peptic ulcers. *J. A. M. A.*, 104: 6 (Jan. 5) 1935.

SURGERY OF RECTAL DISEASES BY ELECTROTHERMIC METHODS

BASED ON 1,100 CASES

DAVID WARSHAW, M.D., F.A.C.S.

NEW YORK CITY

THE use of high frequency current in the treatment of surgical diseases of the rectum was first undertaken by the author about ten years ago after several years of dissatisfaction with other methods known up to that time. In 1931, some 200 cases of hemorrhoidectomy by surgical diathermy were reported.[1] The technique then employed, with certain refinements, has proved so suitable in other rectal conditions requiring surgical intervention that a brief review of its salient features and diverse applicability is presented, in the belief that better results will be the reward of utilizing this method of management.

A critical review of the 1,100 cases embodied in the present report discloses no reason for revising the conclusions previously cited in the summary of advantages, namely: practicability as an office procedure under favorable conditions; minimum loss of blood; freedom from complications, such as fissures, ulcers, abscesses, strictures, or loss of sphincter control; absence of recurrences; short and comfortable convalescence. The present series includes, in addition to external and internal hemorrhoids, fissure-in-ano, fistula-in-ano, pararectal and ischiorectal abscesses, benign and malignant neoplasms, strictures, and pilonidal sinuses, abscesses and cysts.

Although W. L. Clark,[2] after years of experience, urged the use of electrothermic methods in rectal surgery in 1911, a surprisingly large part of the profession is still unfamiliar with the procedure. Mistaken employment of the bipolar current, causing excessive scar formation with resulting stricture, sphincter injury and other complications, has doubtless prompted others to view all electrothermic methods with disfavor. The technique developed by the author emphasizes the uses of the *monopolar current* in these conditions. It is quite sufficient for most purposes, and only exceptionally are the other currents used, as will be shown below.

HEMORRHOIDS

Preparation for Operation. A mild cathartic is given on the night before operation. If there is chronic constipation, a sodium bicarbonate enema should be administered at least two hours before the operation. However, in case there has been a normal, regular movement on the morning of operation, no further measures are taken. Indeed, it is preferable to avoid an enema, as there is then less likelihood of soiling the operative field. An hour before operation the patient is given 10 grs. of soluble barbital by mouth. (Any form of barbiturate may be used.) This is routine as a prophylactic against the toxic effects of novocaine so frequently exhibited by patients. Its employment, thanks to the work of E. G. Martin,[3] has eliminated troublesome, occasionally serious reactions previously encountered. To neurotic patients, a preliminary hypodermic of morphine sulphate, gr. ¼, and atropine sulphate, gr. 1/150, is administered.

Anesthesia. Caudal anesthesia is ordinarily used. Novocaine, 25 to 30 c.c. of a 2 per cent solution, injected into the caudal canal through the caudal hiatus, provides a most effective anesthesia. It is superior to local infiltration because (1) one needle prick only is necessary, while local infiltration requires several needle insertions in a very sensitive area, (2) the operative field is not distorted; (3) the sphincter ani is not

injured; (4) it can be used in spite of edema, thrombosis, ulceration or prolasep without danger of infection. The injection

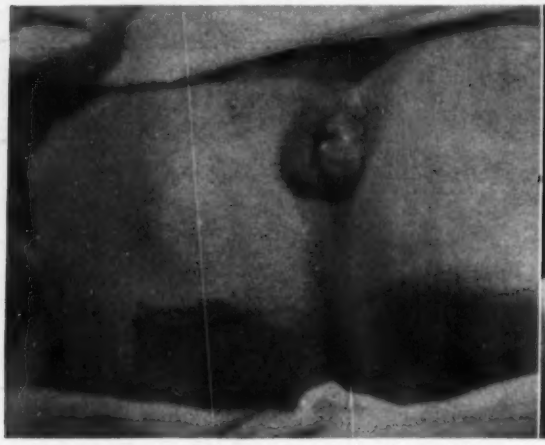


Fig. 1. Successful sacral anesthesia, sphincter relaxed and hemorrhoidal masses bulge outward.

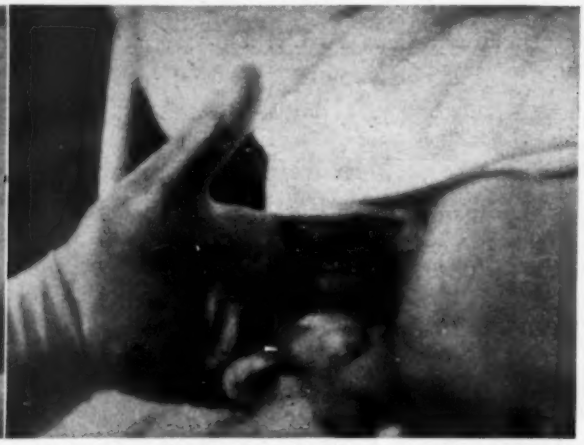


Fig. 2. Completely relaxed sphincter easily divulsed by separating index and middle fingers.

completed and dressing applied, the patient is immediately placed in a lithotomy position and draped, and the perineum is painted with a 3½ per cent solution of iodine.

Inspection and Palpation. The anal region is inspected for pathologic conditions and tested for relaxation of the sphincter. Successful anesthesia produces a completely relaxed sphincter which does not contract when irritated (by the iodine or by pinching the overlying skin). No resistance is offered to gentle divulsion, and examination of the anus and rectum is quite easy. (Figs. 1 and 2.) With a hand on either side of the anus, traction of the skin stretches the sphincter and everts the external and internal hemorrhoids. A clear view is also obtained of fissures, ulcers, polyps, and other pathologic conditions which may exist. Further examination is carried out with the help of a Cook's rectal speculum and, if necessary, proctoscopy.

Equipment. A good diathermy machine capable of delivering a steady spark at least ¼ inch in length, using the monopolar current, is all that is necessary in addition to the usual set-up. Bipolar and cutting currents should also be available; however, as previously emphasized, the bipolar current should not be used for hemorrhoidectomy. The monopolar current is suitable for the removal of most tumors the size of hemorrhoids, requires but little experience for its safe employment, and causes minimum scarring and practically no secondary inflammation.

Operation. With an Allis clamp, the largest external mass is grasped above the mucocutaneous junction and pulled radially, i.e., away from the center of the anal opening. This causes partial or complete eversion of the internal hemorrhoidal mass which is usually found in the same radial plane, with perhaps a slight narrowing at the sphincter, the so-called externo-internal or combined hemorrhoids. (Figs. 3 and 4.) This internal component is now grasped with a second Allis clamp and drawn in the same direction as the first clamp. If the entire internal mass has not thereby been drawn out of the anal canal, a third or even a fourth Allis clamp may have to be applied in the same radial plane as the first and second clamps and traction made outward until the entire mass is exposed. The hemorrhoid clamp is now applied to the base of this combined mass and locked. (Fig. 5.) The base is sometimes so long in its long axis that it occupies the entire length of the hemorrhoid clamp. A second hemorrhoid clamp may even become necessary. Traction of the Allis clamps should be

gently and evenly made; otherwise some of the innermost fibers of the sphincter muscle will be caught in the hemorrhoid

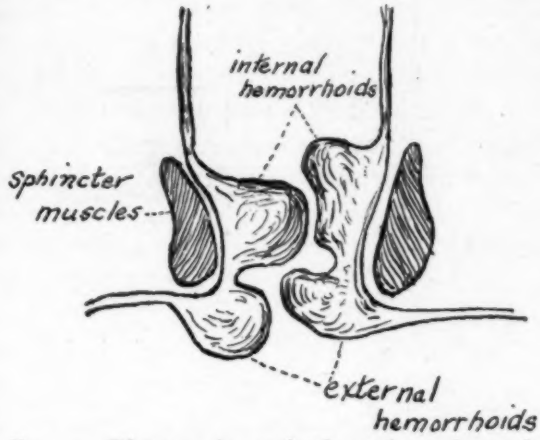


Fig. 3. Diagram in sagittal section of usual arrangement of combined internal and external hemorrhoids.

clamp with resulting postoperative sphincteralgia. A strip of sterile gauze is placed all around the clamp posteriorly, separating the clamp from the underlying anus and adjacent skin. The mass is now ready for electrodesiccation. The Allis clamps are removed and the needle electrode is applied to the mass, the current turned on with the foot-switch while an assistant holds the hemorrhoid clamp. The entire outer surface of the mass is sprayed with the monopolar spark until it becomes gray in appearance. Then the needle is plunged into the mass at regular intervals, thereby desiccating the entire mass in a methodical manner. (Fig. 6.) Boiling fluid and steam, not smoke, will be seen coming from the tissues. Blood caught in the hemorrhoid will trickle out through the puncture holes made by the needle. The needle acquires, from time to time, a coat of coagulated blood or tissue which must be scraped off; otherwise resistance to the transmission of current results, causing sparking from other parts of the electrode.

When the hemorrhoidal mass is dry, gray and shrunken in appearance (Fig. 7) it is cut off flush with the clamp. (Fig. 8.) This may be done with scissors, as is preferable, or with the cutting current of Wyeth. The stump is now treated very thoroughly with the monopolar spark. (Fig. 9.) Not until the stump is thoroughly

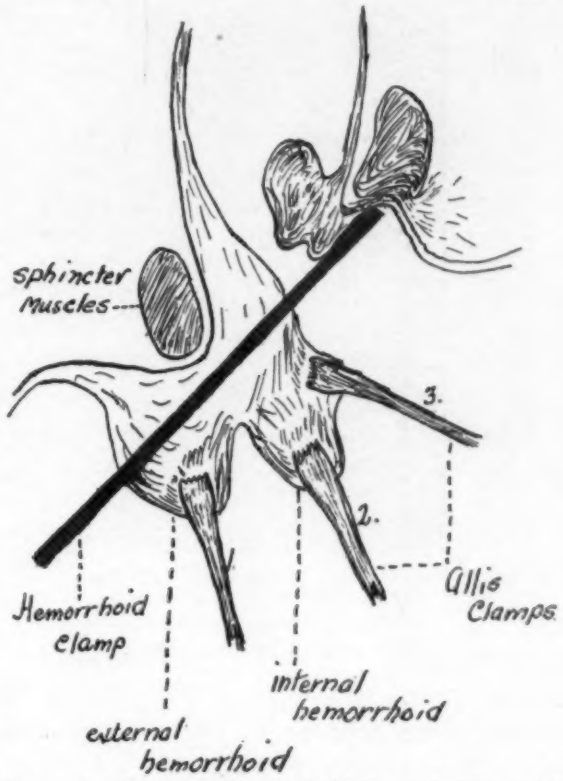


Fig. 4. Application of hemorrhoid clamp (represented by heavy black line) after masses have been pulled downward and outward with Allis clamps, care being taken to avoid the sphincter ani.

dry, almost charred, is the hemorrhoid clamp released, *only one notch at a time*, the stump being further desiccated as it is held between the blades of the clamp. Opening the clamp very slowly enables the operator to detect hemorrhage from inadequately treated areas, which can be controlled at once. It should be remembered that the stump is continuously under traction while in the clamp. Any hemorrhage, especially from the innermost ends of the stump, would at this time be most troublesome and should be avoided by the alternate one-notch-at-a-time release of the clamp and desiccation between the blades until it is evident that the stump is dry and clean. Should bleeding occur, it is treated by further desiccation after insertion of a speculum if necessary; or the bleeding

point may be grasped with an artery clamp and coagulated. If the operation is properly performed, however, there should be absolutely no bleeding, even if the edges of the wound have separated. The author often deliberately separates the edges in demonstration when questioned regarding the possibility of hemorrhage from such a mishap, but nothing other than some negligible oozing occurs. The stump is then released and allowed to return into the anal canal. (Fig. 10.) Successively, the other masses are similarly treated until all are removed, leaving a clean, dry field. Large and small external and internal hemorrhoids may now be removed, reducing the chance of recurrence and preventing the formation of new hemorrhoids from small masses which at the time are either overlooked or invisible because of the bloody field. (Fig. 11.)

Fig. 5. Mass is grasped with Allis clamps and traction made radially. Hemorrhoid clamp applied to the base and locked.

Finally, a small strip of iodoform gauze, liberally impregnated with carbolated petrolatum, is inserted in the rectum. (Fig. 12.) The external end of the strip is pinned or sewed to several squares of gauze which are pressed against the anus. A thick pad held in place by a T-binder is now tightly applied to the perineum. A very efficient T-binder may be made of web elastic 2 inches wide. One strip is fitted around the waist and held with safety pins; the other goes snugly around the perineum, pinned at each end to the waist band and also to the perineal pad to hold the latter in place.

Fig. 6. Fig. 7. Fig. 8. Fig. 9.

Fig. 6. Application of electrode to the hemorrhoidal mass using monopolar current.
Fig. 7. Shrunken appearance after complete desiccation.
Fig. 8. Mass cut off flush with clamp, leaving a desiccated stump.
Fig. 9. Stump of hemorrhoidal mass thoroughly treated with monopolar current until coagulated.

The duration of the operation, depending upon the number of masses removed, is from fifteen to thirty minutes, occasionally longer. Toward the end of a long operation,

2. *Anucaine* (Gorsch)—five parts each of benzocaine and phenmethylol, one part butyl aminobenzoate and one-eighth part novocaine base in sweet almond oil.

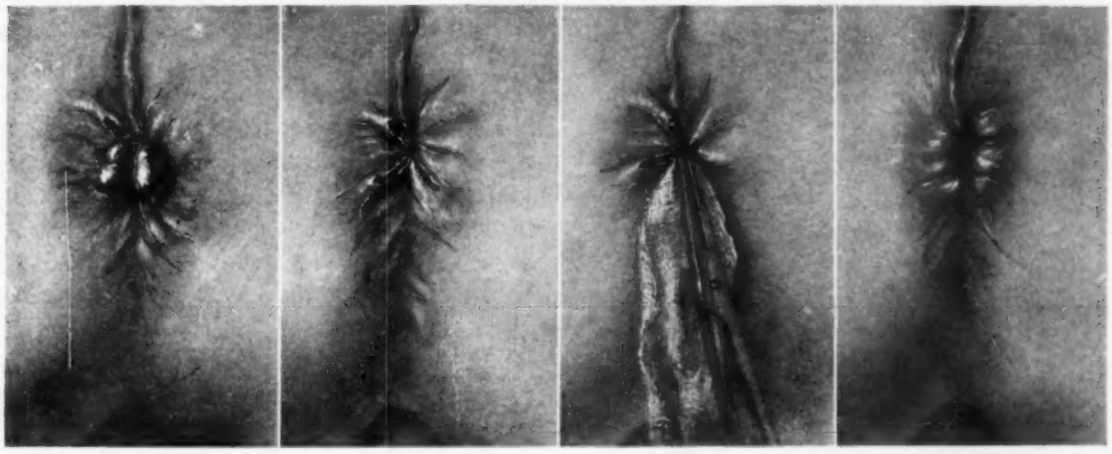


Fig. 10. Fig. 11. Fig. 12. Fig. 13.

Fig. 10. Stump released and allowed to return into the anal canal. Two more hemorrhoidal masses visible. These are treated in a similar manner.

Fig. 11. Operation completed, showing clean, dry stumps of excised hemorrhoidal masses

Fig. 12. Inserting iodoform gauze impregnated with carbolated vaseline. It is pinned to the perineal dressing which is next applied.

Fig. 13. Appearance two weeks later, wounds entirely healed and covered with new mucous membrane. No scars visible. Operative field soft and pliable.

but usually after the operation has been completed, a patient may complain of burning of varying degree. This burning sensation is of short duration, rarely lasting for more than half an hour, and is quickly alleviated by a hot water bag or an electric pad applied to the perineum. A word of caution should be heeded here about the use of an electric pad or hot water bag: due to pain or the burning sensation, the patient may not be aware of the amount of heat exhibited by bag or pad, and unless care is exercised a severe burn of the buttocks or back may be produced, to the chagrin and discomfiture of all concerned. If the immediate postoperative burning is excessively severe, a hypodermic injection of morphine and atropine is given.

In the past few years, to counteract postoperative burning or sphincteralgia, use has been made of the oil soluble anesthetics developed by Yeomans, Gorsch, Morgan and others, such as:

1. *Benacal* (Yeomans)—five parts each of ethacaine and phenmethylol in ninety parts of purified sweet almond oil.

3. *Proctocaine* (Morgan)—basic novocaine 1.5 per cent, butesin 6 per cent, benzyl alcohol 10 per cent, in almond oil.

At the conclusion of the hemorrhoidectomy, especially if extensive or prolonged beyond the duration of the caudal anesthesia, 5 c.c. of the solution is injected into the sphincters posteriorly at about 4 and 8 o'clock. By this means relief of postoperative burning, and pain and sphincter spasm following bowel movements has been most satisfactory, often eliminating the need for any other measures for several days and even weeks.

POSTOPERATIVE CARE AND COURSE

With slight modifications due to location and extent, anorectal operations conform closely to hemorrhoidectomy in postoperative care and course. The patient is kept in bed for two days but is allowed bathroom privileges. Normally, patients pass through a very comfortable postoperative period and in most instances are able to return to work or carry on their usual activities after from four to seven days depending on the

extent and severity of the condition. Examination of the wound next day will reveal a remarkable absence of reactive

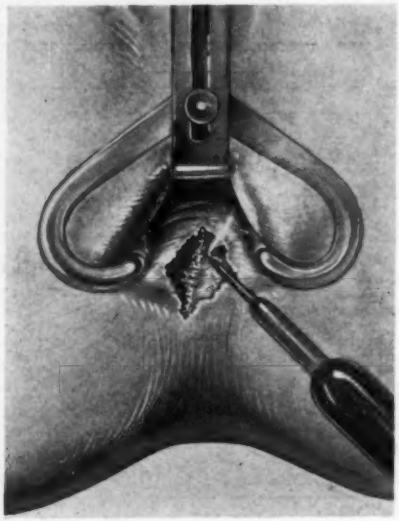


FIG. 14. Fissure-in-ano. Using the monopolar current, the entire base and edges of the fissure are thoroughly desiccated, regulating the strength of the current according to the depth of the diseased tissue.

inflammation. So little have the tissues been damaged that edema, swelling, tenderness, or other evidence of operative trauma, are rarely present. Soon after the second day the coagulated stumps of hemorrhoids begin to slough slightly and separate from the underlying granulating base. From this time until complete healing takes place, about two weeks, there may be a few drops of blood in the stool, or the stool may be blood-streaked. The stool in its passage over the granulating surface causes some bleeding, usually negligible, which stops after the bowel movement and may not be noticed.

Secondary hemorrhage is never to be feared if the technique has been carried out in detail as described. Approximately two weeks after operation the wounds are healed and covered with new mucous membrane (or skin). Scars are seldom visible and, when palpated, are found to be soft and pliable. (Fig. 13.)

Diet and Catharsis. The patient is allowed a soft diet for two days. After the second day, one tablespoonful of an agar oil emulsion may be taken at night, if necessary. After each bowel movement, the anal region in gently washed with a sponge and warm soapy water, and carbolated petrolatum is applied on gauze. It is desirable not to have a bowel movement until the third morning, thereby permitting the operative area to rest. On the second postoperative day, the iodoform gauze packing is removed. Daily, thereafter, morning movements, usually painless, are to be encouraged. A warm olive oil enema, to be retained for ½ to ¾ hour, is very helpful to reduce discomfort or pain of bowel movements. More than one movement daily results in tenesmus. Cathartics or oil should be discontinued, and the tenesmus should be controlled by heat (electric pad, hot water bag or sitz-bath). Rarely are sedatives required, especially if an oil soluble anesthetic has been injected into the sphincters.

FISSURE-IN-ANO AND ULCER

Definition and Pathology. Anal fissure is an irritable ulcer, producing spasm of the sphincter with violent burning pain during defecation or, more usually, after the movement. The pain may last for hours. Examination shows a radial fissure, chronically inflamed and irritated, usually posterior, extending into the anal canal for about ¼ to ½ inch. Hemorrhoids may also be present.

For the eradication of this simple but often most excruciatingly painful condition, monopolar desiccation has proved to be a most valuable agent. It surpasses other known methods both in facility for use and thoroughness with which it removes the ulcer and destroys all inflammatory tissue with a minimum of reaction and postoperative discomfort.

Technique of Operation. After thoroughly cleansing the parts, the area around the fissure is infiltrated with 2 per cent novocaine. Infiltration with an oil soluble anesthetic is even better; indeed, for simple

acute ulcers it may be all that is necessary, putting the part at rest and thereby inducing healing. In case hemorrhoids or other conditions are present, it is best to use caudal anesthesia. The sphincter is then dilated, a Cook speculum inserted and the blades opened. Due to the stretching, the fissure usually appears triangular, its apex pointing into the bowel.

Using the monopolar current, the entire base and edges of the ulcer are thoroughly desiccated, regulating the strength of the current according to the depth of the diseased tissue. (Fig. 14.) Ordinarily, a ⅛ inch spark is sufficient for the purpose of producing a dry coagulum, sealing nerve ends, lymphatics and blood vessels, under which a healthy layer of granulation tissue forms after a few days. For dressing, a thin strip of iodoform gauze impregnated with carbolated petrolatum is inserted a short distance into the canal, with the external end attached to a sterile gauze pad applied to the perineum. Rarely is a postoperative sedative necessary.

On the following day a warm olive oil-glycerine enema will initiate a bowel movement. The average time in bed is twenty-four hours. If hemorrhoids are present they are treated as described above. Details of postoperative care will vary only in degree from the general measures given above.

PARARECTAL AND ISCHIORECTAL ABSCESSES

Abscesses about the anus and rectum, according to their location, are of four types: anal, submucous, ischiorectal, and pelvirectal. Anal abscesses result from infection of a hair follicle or a sebaceous gland, or from a fissure or suppurating external hemorrhoid. Submucous abscesses lie between the mucosa and the muscularis, and may be caused by injury or an ulcerated polyp or hemorrhoid. Ischiorectal abscesses of the acute variety are a form of periproctitis or cellulitis, involving the fossa of the same name, and caused by infection from the rectum, extension of rectal disease, or injury. Chronic ischiorectal abscess is usually tuberculous, occasionally syphilitic. An abscess occurring

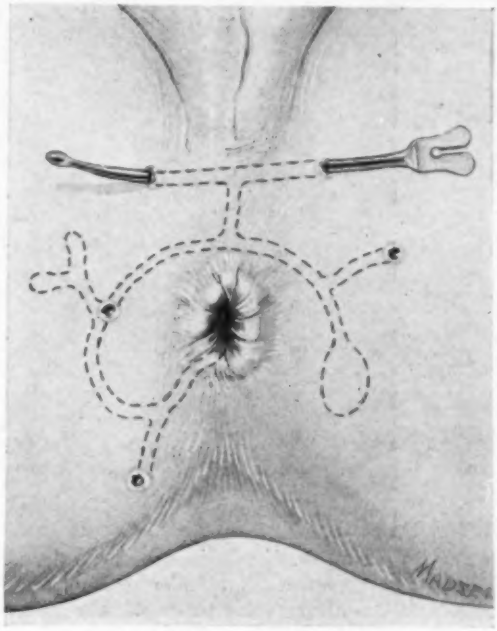


Fig. 15. Fistula-in-ano. Diagrammatic representation of some of the pathological variations of fistula-in-ano. Any part or all of this may be present in one patient.

above the levator ani is called a pelvirectal abscess. These abscesses (pelvirectal) are a urologic problem, since they result, as a rule, from disease of the urethra, bladder, prostate, or female pelvic organs, rather than from rectal affections.

Operation. Abscesses should be incised as soon as they can be localized, and without waiting for fluctuation. The cutting current serves the purpose nicely. Adequate drainage should be maintained until the accumulated pus has been evacuated and healing from the bottom encouraged to prevent recurrence. In the case of extensive involvement, this may entail irrigations with boric or saline solutions.

FISTULA-IN-ANO

Definition. A fistula is a persistent, burrowing and often tortuous sinus, the result of an unhealed abscess. It may be complete or incomplete. An incomplete fistula opens on one surface only, and is

designated *external* if it opens outside the anorectal line, or *internal* if it opens into the rectum above the anorectal line. A complete fistula opens both above and below the anorectal line, with a continuous tract connecting the two openings. The tract may branch and have several openings, internal and external, and is lined with chronically inflamed tissue. Fistulous tracts may be found at varying depths below the skin or mucous membrane, superficial to or below the sphincter muscle. They may be specific, e.g., carcinomatous, syphilitic or tuberculous, or non-specific, i.e., inflammatory. (Fig. 15.)

Fig. 16. Fistula-in-ano. A simple, complete fistula. Under local anesthesia, after passing a probe through the tract, the fistula is being split open with cutting current.

Fig. 17. Fistula-in-ano. The tract is split wide open. It is dry and bloodless. The trough of chronic inflammatory tissue is now thoroughly desiccated with the monopolar current.

Operative Technique. With the possible exception of the carcinomatous type, anorectal fistulae, both specific and non-specific, are easily eradicated by surgical diathermy. Its use provides a practically bloodless operative field; tissues retain their natural color, and the sinus tracts, whether simple or branched, are easily recognized and followed. Caudal anesthesia is preferred to infiltration, because it does not distort or conceal the tract.

A simple fistula is laid open as it is traced (Fig. 16), and the resulting fissure is destroyed by electrodesiccation, as previously described. (Fig. 17.) Fistulae that branch or involve the sphincter demand careful preliminary estimation of their extent, to avoid the pitfall of cutting sphincter fibers in more than one place. The sphincter ani muscle may be cut sharply across once with impunity. If, however, a branching fistulous tract involves the muscle is more than one place, a subsequent operation or operations should be performed after the first transection has healed. Figure 18 (A and B) shows the wrong and the right way to cut across the sphincter after tracing a sinus with a probe. The endotherm knife should be made to cut at right angles to the fibers down to the probe or grooved director. With the tract thus laid wide open, bleeding vessels are caught with hemostats and coagulated with the bipolar current. The tract is then destroyed with the monopolar current. (Fig. 17.) No sutures are used. The wound is packed wide open with iodoform gauze, which is left in situ for three to five days, and a perineal bandage applied.

It is not necessary to splint the bowels with opium and bismuth. The bowels will

probably remain inactive. If a movement takes place, it is preferable that it occur in the presence of the packing. Should the latter become dislodged as the result of a bowel movement, the wound is thoroughly irrigated with warm boric solution or normal saline and repacked carefully to insure healing from the bottom of the wound, thus avoiding recurrence. A soft, pliable scar with very little, if any, contracture is the usual result.

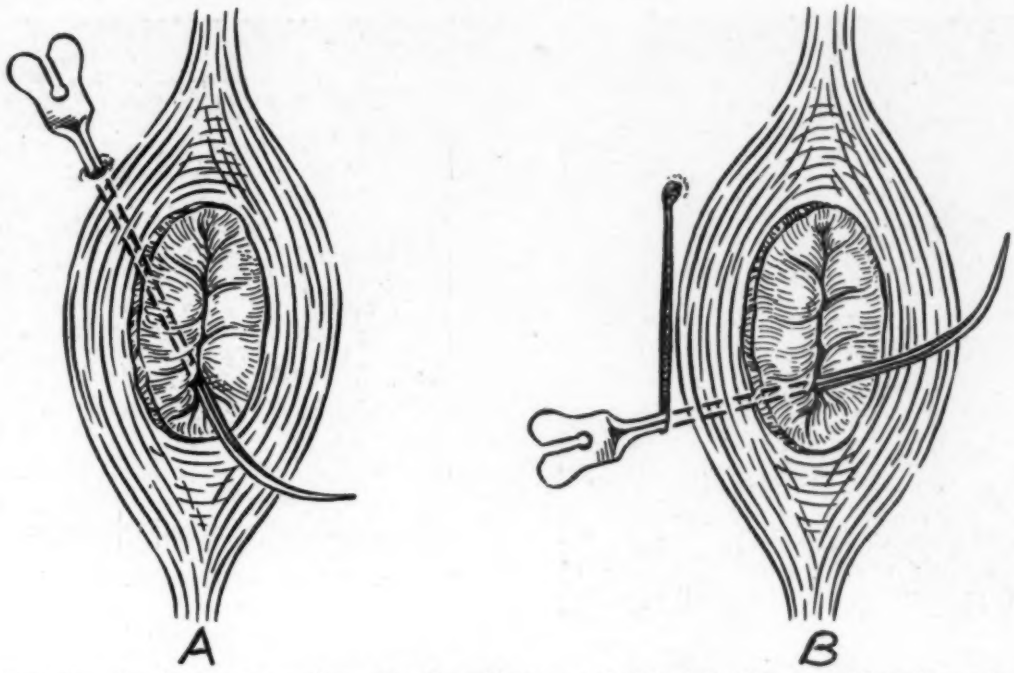


Fig. 18. A, fistulous tract crossing under the sphincter on the bias. The fibers should not be cut in this direction. The direction of the probe should be corrected by another incision if necessary as in B, so that the fibers will be cut across at a right angle.

POLYPS AND OTHER BENIGN GROWTHS

Polyps are very easily removed by electrothermic methods. After suitable preparation and proper exposure, using either Cook's or Hirschman's speculum, preferably of non-conducting material, the polyp is grasped with an Allis clamp and its pedicle completely desiccated, after which it is cut off with cutting current or scissors. Another method is to use a small wire snare of the tonsillotome type connected with the active electrode of the bipolar current. The pedicle is encircled by the snare and lightly constricted; the current is turned on, slowly producing coagulation of the pedicle, after which it is severed by complete constriction. No further treatment is necessary.

Any benign neoplasm having a pedicle is, in essence, a polyp, the underlying pathology of each serving merely to place it in the category of adenoma, lipoma, fibroma, myoma, lymphoma, myxoma or angioma, to mention a few. Non-malignant growths which are the local manifestation of systemic infection, notably syphilis, tuberculosis, gonorrhea or amebiasis, are removed only after the primary disease has been relieved or corrected by appropriate measures. Adaptation of electrothermic methods to eradicate the local tumors is frequently feasible and, where this is the case, distinctly to be recommended because of the thoroughness, slight reaction and pliable scar which feature the results secured.

MALIGNANT GROWTHS

Of the three types of malignant growths, epithelioma, carcinoma, and sarcoma, the first is the one which, because of its superficial location and tardy metastasis, may

be removed most satisfactorily by surgical diathermy. However, there is abundant evidence that the cutting current prevents the dissemination of malignant cells to contiguous tissues, considered by many to occur as a result of ordinary dissection. The comparative absence of hemorrhage, facilitating the recognition of tissues; the prompt control of bleeding points, conserving the patient's resistance, and the admirable character of the scar, because of minimum reaction and early healing, are advantages especially appreciated in operations requiring maximum speed and minimum trauma.

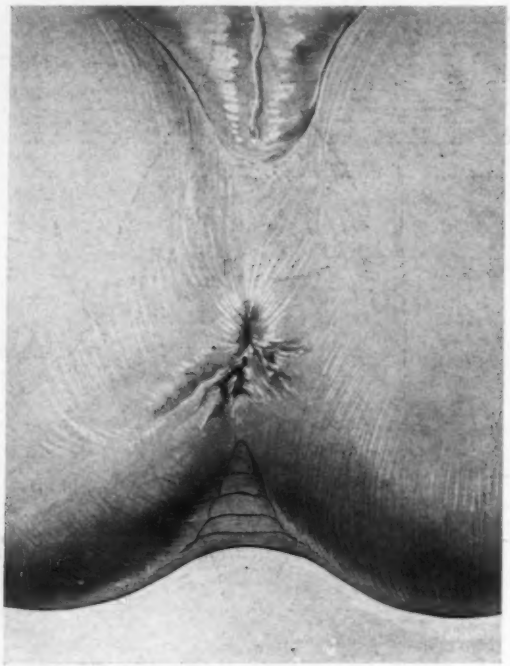


FIG. 19. Stricture of the anus. Result following a Whitehead operation. Chronic intestinal obstruction. Pencil stools.

Where large, bulky, fungating, inoperable neoplasms are encountered, their removal by means of the cutting current followed by coagulation of the base is an admirable and satisfactory method of preparation for immediate or subsequent radiation therapy.

STRICTURES

In benign strictures of the rectum, especially the postoperative, post-traumatic or congenital types, posterior proctotomy with the cutting current is particularly valuable. Due to the slight inflammatory reaction, there is a minimum of fibrous tissue formation, and a soft, pliable scar, with an adequately enlarged opening, is the result.

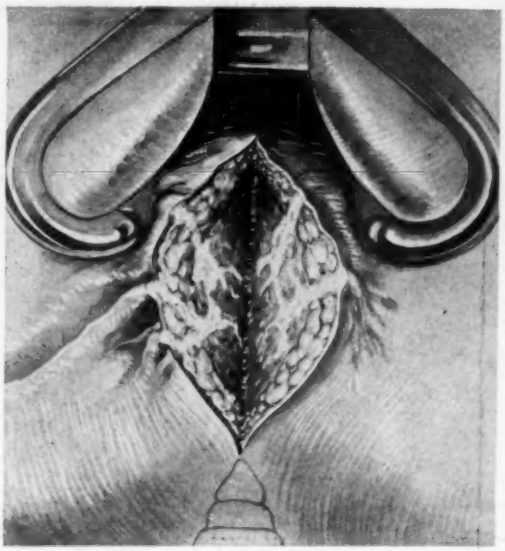


FIG. 20. Stricture of the anus. Posterior proctotomy with the cutting current. The incision was carried down posteriorly in the midline almost to the coccyx, and upward in the canal for about 1½ to 2 inches until soft tissue was reached. The opening was thus enlarged to an area admitting several fingers.

The Whitehead operation for hemorrhoids, which unfortunately is still popular in some sections of this country, has been responsible for many cases of incontinence or stricture. The author has among his records one especially serious case of post-Whitehead stricture resulting in chronic intestinal obstruction. Rectal examination was impossible, even with the little finger. There was a rigid fibrous ring instead of an anal canal. The patient had occasional pencil-like stools, but to secure sufficient evacuation, resort to cathartics and purges to keep the stools watery was necessary. Relief for this patient (Fig. 19), a typical case, was secured as follows:

Operation. With the patient in the lithotomy position, under caudal anesthesia, using 2 per cent novocaine, a

posterior proctotomy was performed with the cutting current. The incision was carried down posteriorly in the midline almost to the coccyx, and upward in the canal for about 1½ to 2 inches, until soft tissue was reached. Thus the strictured rectum was enlarged to a diameter admitting several fingers. (Fig. 20.) The wound was packed with iodoform gauze and allowed to heal from the bottom. A most satisfactory result was obtained. The rectum was amenable thereafter to speculum and finger examination, and the patient was able to enjoy normal bowel movements.

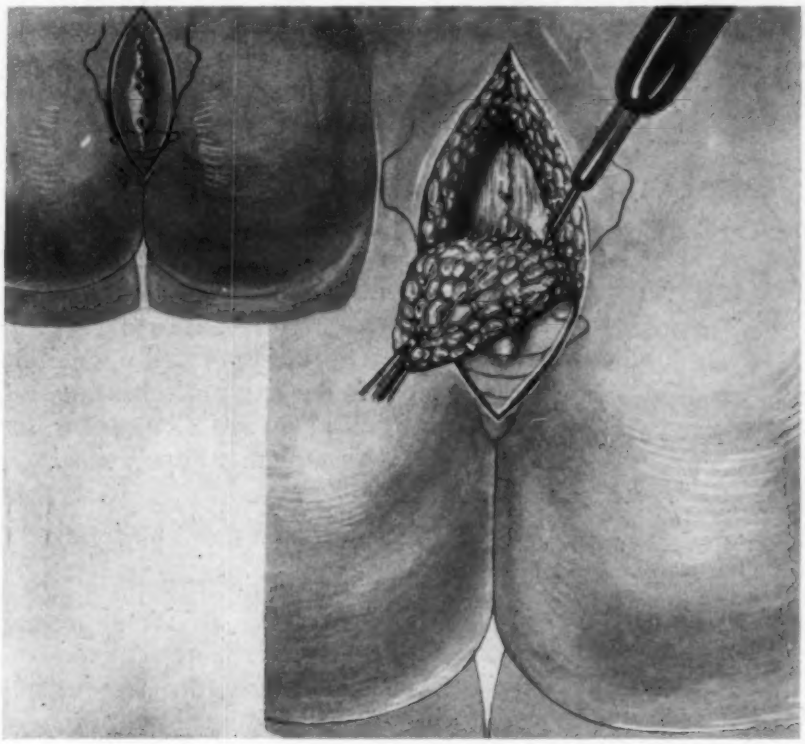


Fig. 21. Pilonidal sinuses (insert). Operation—after determining the extent of the diseased area, it is excised en masse with the cutting current.

PILONIDAL CYSTS, ABSCESSES AND SINUSES

Pilonidal cysts and sinuses are formed as sequestration cysts, i.e., from the inclusion of a portion of the epiblast (ectoderm) in places where embryonic segments unite. A frequent location is the coccygeal region. Whether the cysts are congenital, or the hairs work their way into a congenital sinus and later, because of irritation and inflammatory reaction, become encysted, is not important to the discussion of management.

The conditions most frequently encountered are simple cysts, acutely inflamed cysts, abscesses with one or more discharging sinuses and chronic suppurative branching sinuses. Their response to electrothermic methods of excision preferably, or to destruction as in fissure or fistula, is most gratifying. The wounds heal cleanly and benignly. Postoperative pain is minimal and recurrence is rare.

Field block infiltration with 2 per cent novocaine is induced. With a flexible probe the extent, character and direction of the sinuses or cavities, or both, are determined.

Two modes of procedure are then open to the surgeon: (1) exposure of the sinus or cavity, as in fistula, evacuating its contents and destroying all visibly diseased tissue by coagulation or dessication; and (2)

excision en masse of all disease-bearing tissue down to fascia. (Fig. 21.) The writer prefers the latter for the following reasons:

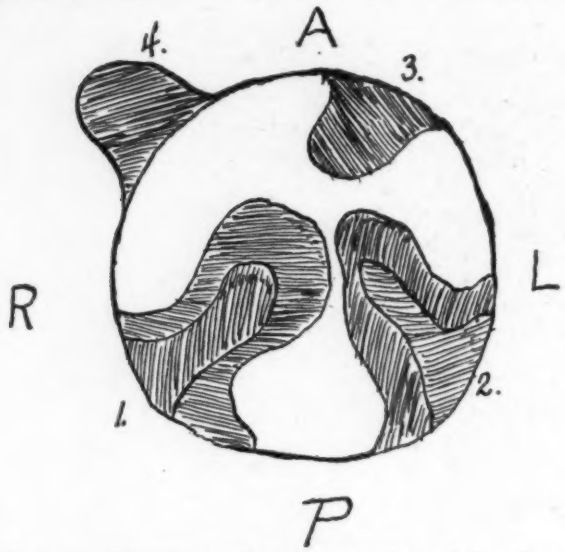


FIG. 22. Diagrammatic representation of location, type, and extent of anal pathology, for use on patient's history sheet. R, right; L, left; P, posterior; A, anterior. 1 and 2, combined internal and external hemorrhoids. Fissures, fistulae, polyps, ulcers etc., may be similarly located on the chart.

1. Removal en masse permits one to work only in clean healthy tissue by employing an elliptical incision encompassing all diseased tissue, even an entire abscess, leaving a clean dry uninfected wound.

2. Such a wound may be closed immediately, after undermining the edges, with a fair chance of obtaining primary union and thereby saving many weeks of wound care. Even if the wound is left open and packed with gauze, healing is cleaner and more rapid.

3. In the rare case where the disease extends beyond the fascia, a better opportunity is afforded for radical extirpation of such disease.

4. There is less likelihood of leaving a portion or branch of a sinus behind, to make recurrence inevitable.

One disadvantage is that for en masse extirpation the patient must usually be hospitalized for three to six days, while simple sinus exposure and coagulation may under suitable conditions be safely performed in the office.

A simple diagram is made on the patient's chart, showing the approximate locations and size of the operative areas. (Fig. 22.) This chart has assisted materially in subsequent follow-up examinations. Should a patient return with more hemorrhoids, or other pathology, reference to the diagram will indicate whether or not the mass or masses recurred in the previously operated area or have formed anew in areas not operated upon. The patient is not discharged until healing is complete and his case is followed for at least a year subsequent to operation.

SUMMARY

1. A brief résumé of the electrosurgical treatment of rectal diseases has been presented.

2. Over 1,100 cases have been treated by methods described.

3. Compared with other methods the following advantages are claimed:

(*a*) Under suitable conditions, most patients may be treated in the office.
(*b*) There are no complications, such as serious infection, fissure, fistula, ulcer, abscess, stricture or incontinence.
(*c*) There is no blood loss.
(*d*) Secondary hemorrhage is rare.
(*e*) Recurrence is extremely rare.
(*f*) Convalescence is much shorter and much more comfortable than with other methods.

REFERENCES

1. WARSHAW, D. *Am. J. Surg.*, 11: 45–50 (Jan.) 1931.
2. CLARK, W. L. *Am. J. Elec. & Radiol.*, 30: 226, 1921; 93: 329, 1925.
3. MARTIN, E. G. *J. A. M. A.*, 91: 555, 1928.

URINARY ANTISEPTICS WITH SPECIAL REFERENCE TO A CLINICAL STUDY OF BENZOCHROME

ALBERT DECKER, M.D., F.A.C.S., AND MEYER TEXON, M.D.

NEW YORK CITY

THE many physical and chemical problems involved in the search for the ideal urinary antiseptic for internal use make it highly improbable whether such a universal panacea will ever be found. Much advance has been made, however, in emphasizing the apparent selectivity of certain chemicals for certain bacterial groups and for specified conditions. Furthermore, the value of internal urinary antiseptics will certainly depend on whether the condition treated is simple or complicated.

Oil of Santal. Oil of santal, one of the oldest of urinary antiseptics, was once regarded as highly specific for gonorrheal urethritis. Jordon,[1] in 1913, found the urine, after administration of oil of santal, germicidal to staphylococci, but colon bacilli were not influenced by the same medication. The Council on Pharmacy and Chemistry of the American Medical Association recognizes oil of santal. It is less popular than formerly but still has a place among urinary antiseptics.

Methenamine. The chemical hexamethylenetetramine was introduced to medicine under the name urotropin more than forty years ago. It is recognized in the pharmacopeia as methenamine and is widely prescribed in the treatment of infections in the urinary tract. Methenamine requires concentration of the urine (limited fluids) and time to permit accumulation of formaldehyde in antiseptic amount. The urine must be acid (*pH* of 5.6 or less) in order to be rendered effectively germicidal by methenamine. An acidifier such as ammonium nitrate or ammonium chloride thus greatly enhances its antiseptic value.

Methylene Blue. Methylene blue is one of the diphenylamine dyes which also include gentian violet, acriflavine and mercurochrome. In 1891 Einhorn[2] found methylene blue a useful urinary antiseptic and efficient either by mouth or by rectum. Later it was pointed out the changes to leuco forms in the body rendered it practically non-germicidal. Hinman[3] administered methylene blue with methenamine and considered it of value in staphylococcic infections of the bladder and kidneys. Other workers have found methylene blue and acriflavine disappointing and have pointed out irritating effects on both the digestive and urinary system.

Acriflavine. The action of acriflavine is more pronounced when urine is alkaline, hence bicarbonate is given at the same time. Acriflavine is apt to produce gastrointestinal disturbances.

Pyridium and Azo-Dye Therapy. These preparations have proved a valuable aid in a majority of cases when used but also have utterly failed at times. Walther and Willoughby[4] recently reviewed the value of these drugs in 1,500 cases. The following conclusions were drawn: (1) They work equally well in acid and alkaline media. (2) No special dietary régime is required when they are used. (3) They have a soothing effect on inflamed mucous membranes and probably penetrate the tissues to attack bacteria. (4) Certain coli and staphylococci are retarded.

Hexylresorcinol. This drug was found by Leonard[5] of value in adults with chronic infection of the urinary tract, due to staphylococcus albus and aureus and some strains of B. pyocyaneus. Walther[6] did not find such encouraging results with this drug when given to children.

Ketogenic Diet. This régime depends on a highly acid urine for its bactericidal effect (*pH* 5.3 or less required). The ketogenic diet often causes gastrointestinal disturbances. Therefore, attempts to produce an acid urine in other ways were undertaken.

TABLE I

No.	Name	Sex	Age	Symptoms	Urine	Diagnosis	Therapy	Results	Remarks
1	D. N.	F	25	Frequency and hematuria for 3 days.	8/10/37—Many pus and R.B.C./HPF.	Cystitis	Picochrome* 1 caps. 4xd.	Improved 8/17/37 Urine negative.	
2	J. S.	F	19	Frequency and slight right upper quadrant ache for 10 days.	6/10/37—Few pus cells/HPF.	Cystitis	Picochrome	Improved 6/15/37, 6/16, 8/13 Urines negative.	
3	M. O.	F	36	Frequency, chills and fever. Pain in right loin.	8/5/37—Few clumps of pus cells.	Pyelonephritis Stone(?)	Picochrome	Clinically improved 8/13/37	Stone in left kidney removed 2 years before.
4	E. M.	M	49	Nocturia 1 or 2 times, frequency and dysuria.	7/14/37—Numerous pus cells.	Cystitis	Picochrome	Improved 7/29/37 —occasional W.B.C. 7/30/37 —symptom-free.	G.C. 3 years previously.
5	V. D.	F	28	Pain on right side, frequency, nocturia and dysuria.	5/22/37—4–5 wbc/HPF.	Pyelocystitis	Picochrome	Improved 5/24. Better 6/1. 6/12 cured.	
6	M. M.	F	19	Feverish, backache and dysuria for 2 days.	W.B.C. in numerous specimens.	Acute and chronic pyelitis	Picochrome	Improved clinically in 2 weeks. W.B.C. persist in urine.	
7	M. L.	F	42	Pain in right loin, chills and fever, frequency and dysuria.	5/15/37—2/albumin. Few R.B.C. and W.B.C.	Pyelitis	Picochrome	5/30/37 } Improved but W.B.C. persist in urine. 6/ 5/37 }	Cystoscopy and pyelograms normal—no stone.
8	E. A.	F	62	Frequency.	6/4/37—R.B.C. and pus cells.	Recurrent cystitis	Picochrome	6/28/37—Urine negative.	Also had argyrol instillations.
9	H. M.	M	42	Hematuria, frequency and dysuria, 2 days.	4/15/37—Cystoscopic specimen (right), few clumps of pus.	Pyelocystitis	Picochrome	4/27/37 } Urine 5/ 4/37 } negative.	Pyelogram negative.
10	A. B.	F	45	Frequency and suprapubic pain.	5/22/37—Few pus cells.	Cystitis	Picochrome	6/29/37—Urine negative. Asymptomatic in 2 weeks.	Menopause symptoms.
11	F. B.	M	45	Fever and right-sided pain.	5/11/37—Many pus cells.	Acute pyelocystitis	Picochrome	6/24/37—Few pus cells but was symptom-free 6/6/37.	G.C. prostatitis.
12	M. W.	F	25	Frequency and dysuria for 2 months.	9/1/37—Few pus cells.	Cystitis	Picochrome	9/11/37—Improved. 9/15/37—Improved but urine shows few W.B.C.	7/5/37—Postpartum. 11/3/37—W.B.C. in urine but asymptomatic.
13	H. R.	F	29	Backache, frequency and dysuria for 10 days.	11/12/37—Loaded with pus cells.	Acute cystitis	Picochrome	11/15/37—Improved—no pain —numerous W.B.C. in urine. 11/17/37—Urine negative.	
14	P. D.	F	37	Frequency, dysuria and suprapubic pain for 1 week.	11/27/37—Urine loaded with pus; albumin faint trace.	Cystitis	Picochrome	No further dysuria. 11/29/37—Urine negative. Improved.	
15	N. L.	M	25	Fever, malaise, right loin pain for 1 week.	Urine neg. for 1 week, then contained innumerable pus cells.	Pyelonephritis and abscess	Picochrome	Unimproved.	Nephrostomy

*Since this paper was received for publication, the name of the product was changed to benzochrome.

TABLE I (*Continued*)

No.	Name	Sex	Age	Symptoms	Urine	Diagnosis	Therapy	Results	Remarks
16	L. R.	F	61	Hematuria, frequency and suprapubic pain for 1 week.	6/9/37—Many W.B.C.	Chronic systitis	Argyrol Picochrome*	Had argyrol instillations without effect. Symptom-free after 1 week of picochrome.	6/16/37—Urine negative under argyrol but symptoms persisted.
17	K. G.	F	40	Backache, frequency for 6 months.	5/26/37—Urine loaded with pus cells.	Pyelocystitis	Picochrome	Urine from right ureter 5/27/37 showed W.B.C., 6/25 occasional W.B.C.	9/3/37—Urine negative and asymptomatic.
18	I. B.	F	35	Backache, frequency, dysuria and right pain for 1 week.	Urine negative.	Cystitis	Picochrome	Urine always negative. Became symptom-free after 1 week.	Chronic salpingitis.
19	C. K.	F	51	Dysuria and pain over right kidney area, 2 months.	6/9/37—Innumerable W.B.C. and R.B.C.	Pyelocystitis	Picochrome	6/16—Pain over right kidney and started picochrome: 6/29 no burning and negative urine. 8/4 negative.	
20	M. C.	F	29	Dysuria and right sided pain for 4 days.	8/7/37—Pus cells and clumps.	Pyelocystitis	Methenamine Picochrome	8/1/37 methenamine. 8/8 pain persists. 8/13 picochrome. 8/28 few W.B.C. 8/20 negative urine and symptom-free.	
21	M. Q.	F	31	Suprapubic pain, dysuria nocturia frequency 1 week.	10/30/37—Urine loaded with pus cells. Few R.B.C.	Acute pyelocystitis	Picochrome	11/6/37 cystoscoped-pus, cells from both ureters. 12/7/37 cured.	Pyelograms negative
22	A. L.	F	25	Frequency, dysuria and right loin pain 1 week.	4/24/37—Urine contains few pus cells.	Pyelocystitis	Picochrome	4/27/37 Cystoscopy. 5/22/37 had negative urine and asymptomatic.	
23	S. S.	F	26	Pain in right kidney area, fever, frequency, recurrent attacks in past year. Gravid.	1/30/37—Urine shows many pus cells and clumps. Few R.B.C. albumin faint trace. 2/2/37—Fever. Pus cells persist. 5/9/37—Recurrence of symptoms and pus in urine.	Pyelocystitis in pregnancy	Bed rest, fluids, alkalies. Picochrome Picochrome	Improved. Symptoms cleared but W.B.C. remain. 6/11—Symptoms-free, W.B.C. persist.	Delivered 7/25/37. August—cystoscopy—W.B.C. and clumps function normal, pyelogram normal. 11/9/37—Urine negative.
24	H. G.	F	38	Frequency and pain at the left loin, feverish.	8/16/37—Pus cells in urine.	Pyelocystitis	Picochrome	8/18/37—Pus cells in urine. 8/22/37—No complaints. 8/27/37—Few W.B.C. 9/25 urine negative.	Postoperative. Had cyst in the broad ligament and removal through vagina.
25	P. B.	F	42	Suprapubic pain, right kidney area pain, frequency, dysuria, fever.	11/24/37—Urine loaded with pus cells.	Cystitis and right pyelitis	Picochrome	Asymptomatic in 4 days. Pus cells remain in urine until 1/14/38—negative albumin. No W.B.C.	Cystoscoped (right pyelitis).

Mandelic Acid. Mandelic acid is a hydroxy acid, non-toxic and excreted unchanged. It renders the urine bacteriostatic. It is usually given as sodium or ammonium mandelate in syrup, 3 Gm. in ½ ounce dose. It is of value against coccal and bacillary infections, but should be avoided if there is kidney damage. It will need a longer trial before it can be declared a panacea, since its limitations include: (1) The urine must be acid (*pH* 5 or less). (2) Gastrointestinal upsets are not uncommon. (3) The drug has an unpleasant taste unless skilfully disguised.

Sulfanilamide. Helmholz[7] showed that the urine of patients taking this drug developed definite bactericidal power against certain organisms commonly found in urinary tract infections. Workers have found favorable results in infections due to Escherichia coli and Aerobacter aerogenes. Less effective results were observed in infections with Staphylococcus aureus, Streptococcus buccalis and Proteus vulgaris. Reports also favor the use of this drug against gonococcal infections. Evidences of toxicity are many and varied and must be looked for. Cessation of medication is indicated at their first appearance. Combating coccic infections appears to be the chief value of sulfanilamide.

This brief review shows that none of the present day urinary antiseptics can be called a specific. Each preparation has its value and indication in particular instances. Each new drug introduced should be given a trial. It will then certainly find its own niche in the armamentarium for combating urinary infections. It was with all these facts in mind that a clinical trial of an azo-dye compound product known as benzochrome was undertaken. Protocols of twenty-five consecutive cases are shown briefly in Table 1.

SUMMARY

In the present series there were twenty-five patients, twenty-one females and four males. The ages ranged from 19 to 62 years, with an average of 36. The urinary symptoms included frequency, dysuria, malaise, fever, suprapubic, right lower quadrant, right loin and lower back pain. The diagnoses included cystitis, pyelitis, pyelocystitis, pyelonephritis, kidney abscess and nephrolithiasis. Benzochrome was used consistently and in three instances following argyrol instillation, an alkaline régime and methenamine respectively. Benzochrome uniformly gave symptomatic relief and in most cases urinary abnormalities vanished. In a few cases relief was noted despite persistence of pus cells in the urine. Patients were noted to remark about the freedom from burning on urination after benzochrome medication. In the above cases no attempt was made to influence the diet or reaction of the urine. The urines examined were all acid to litmus paper.

CONCLUSIONS

1. Simple urinary infections appear to respond uniformly well to benzochrome.
2. Benzochrome was found in twenty-five cases especially valuable in producing prompt relief from dysuria and other painful symptoms.
3. There are no cumbersome procedures to be carried out during the administration of benzochrome. Because of this, as well as the absence of complications due to its apparent freedom from toxic properties, benzochrome may well be used in the treatment of properly selected cases of urinary tract infections.

REFERENCES

1. Jordan, A. Report on urinary antiseptic. *Brit. M. J.*, 2: 648, 1913.
2. Einhorn, Max. Ueber die Anwendung des Methylenblau bei Cystitis, Pyelitis and Carcinom. *Deutsche med. Wchnschr.*, 17: 620, 1891.
3. Hinman, Frank. Urinary antiseptics. *J. A. M. A.*, 65: 1769, 1915.
4. Walther, H. W. E., and Willoughby, R. N. Oral dye therapy in urogenital infections. *Am. J. Surg.*, 25: 460, 1934.
5. Leonard, Veoder. *J. A. M. A.*, 83: 2005, 1924.
6. Walther, H. W. E. *South. M. J.*, 22: 161, 1929.
7. Helmholz, H. F. *Proc. Staff Meet., Mayo Clin.*, 12: 244, 1937.

HEART DISEASE IN PREGNANCY: OBSTETRICAL ASPECTS*

THOMAS R. TURINO, M.D. AND ARTHUR T. ANTONY, M.D.

Assistant Attending Obstetrician and Gynecologist, Brooklyn Hospital

Assistant Attending Obstetrician and Gynecologist, Brooklyn Hospital

BROOKLYN, NEW YORK

IT is a generally accepted fact that, with few exceptions, in medical or surgical complications of pregnancy our attention should be directed to the treatment of these conditions rather than to the pregnancy. This axiom cannot be over-emphasized in the management of the pregnant woman with heart disease. It is a problem which should be shared equally by the internist and the obstetrician. In the last five years at the Brooklyn Hospital, we have attempted to fulfill this requirement for care of the cardiac patient who must bear the burden of pregnancy, in that the personnel of the prenatal cardiac clinic is made up of both cardiologists and obstetricians.

During the ten year period ending July 1935, there were 110 patients with organic heart disease who were followed through 150 pregnancies. Four additional pregnancies were cared for prior to admission to the prenatal cardiac clinic. This number does not include patients admitted to the private pavilion. There were 102 patients with rheumatic heart disease, three with pulmonary stenosis of congenital origin, three with arteriosclerosis, and two with cardiac hypertrophy of unknown cause.

Eighty-one were primiparae and seventy-three multiparae. Of the latter there were thirty-eight para 2, twenty para 3, five para 4, five para 5, one para 6, one para 8, one para 9, one para 12, and one para 13.

The presentations encountered in this group of patients show the usual preponderance of anterior positions, with the L.O.A. most common. The others presented an interesting variety for the obstetricians to contend with, as indicated:

L.O.A.	62
R.O.A.	28
R.O.P.	23
L.O.P.	11
Breech	4
Face	2
Brow	1
R.O.T.	3
L.O.T.	2

AVERAGE DURATION OF LABOR

	Primiparae	Multiparae
First stage	11 hours 55 min.	9 hours 25 min.
Second stage	1 hour 10 min.	56 min.
Total labor	13 hours 15 min.	10 hours 26 min.

Labor in the cardiac patient often has been said to be of shorter duration than in the non-cardiac. The average length of labor in the primiparae was thirteen hours and fifteen minutes, and in the multiparae ten hours and twenty-six minutes. Daichman and Kornfeld[5] of Brooklyn, on the other hand, found an average duration of labor in eighty-two primiparae with heart disease to be twenty and a half hours, and Bristol Nelson of Boston [6] reported no difference in the labors of cardiac as compared with non-cardiac patients.

The length of the second stage in our series (one hour and ten minutes for primiparas and fifty-six minutes for multiparas) may seem unduly long. All authorities on the subject agree that the second stage of labor is a great strain on an already over-burdened myocardium, and should therefore be shortened or eliminated by delivery as soon as the cervix is fully dilated. We have been fully aware of the value of helping these patients through the second stage. However, the fact that in

* From the Medical and Obstetrical Services of the Brooklyn Hospital. Read at a Meeting of the Brooklyn Gynecological Society, October 3, 1936.

many instances the patients' general condition and progress in labor were satisfactory may have justified the delay.

It has been erroneously believed by some that the first stage of parturition entails little or no strain on the patient. This is far from the truth. The anxiety, loss of sleep, lack of nourishment, and pain which accompany this initial stage of labor must certainly play a part in the depletion of the patient's reserve energy. It is in this interval that the judicious use of analgesia, preferably morphine, may avoid the precipitation of cardiac insufficiency.

At Brooklyn Hospital, when a cardiac patient is admitted in labor, medical consultation is obtained and the patient is followed jointly by the medical and obstetrical attendants.

Analysis of the vaginal deliveries shows a high incidence of operative interference as compared with any group of non-cardiacs.

METHOD OF VAGINAL DELIVERY

	Manual Control	Forc. Cont.	Low Forc.	Mid Forc.	High Forc.	Spon. Breech	Breech Extract.
Primiparae...	9 (4 prematures)	28	25	1	0	1	0
Multiparae...	40	6	12	2	1	2	1

The choice of anesthesia for cardiac obstetric patients is a very important problem. Our usual routine for non-cardiacs in this hospital is to use gas-oxygen and ether. In this series we note the frequent use of open ether anesthesia. Most writers in this subject agree that open ether is the anesthetic of choice for this type of patient. Local anesthesia where applicable, as in prophylactic forceps or perineal forceps and in cesarean section, is perhaps the ideal anesthetic. At present it is finding more and more use and may in time be chosen more frequently than ether. However, in the nervous, anxious woman, it is not as valuable. For local anesthesia, adrenalin should not be combined with novocaine as its effect on the circulation is undesirable.

Carr and Hamilton,[6] of Boston, state that: "All drugs to induce anesthesia administered by mouth or parietally, except by inhalation, are open to objection. The obvious objection is that the dose cannot be estimated accurately to fit all cases." In their experience, "When bad risk patients failed to survive, they died a few hours after delivery while still unconscious." They go on to say that "if one has given anesthetic drugs by mouth or injection, the picture is clouded and one wishes he had not given it."

Spinal anesthesia has some advocates, but most authorities believe it is contraindicated. Certainly once administered it cannot be controlled. In the opinion of J. P. Greenhill,[8] pregnant women are especially susceptible to complications after spinal anesthesia, and he believes it is very dangerous for women with cardiac decompensation. Sabel[10] of Philadelphia states that spinal anesthesia should not be used in patients having very large abdominal tumors, and he quotes Winter and Volcker as definitely rejecting spinal anesthesia for cesarean sections. It seems to us that the Trendelenburg position after the administration of spinal anesthesia must add to the cardiac embarrassment by virtue of the pressure it produces on the diaphragm and the interference with venous return from the head.

ANESTHESIA FOR VAGINAL DELIVERY

	G. and O.	G.O.E.	Open Ether	None
Primiparae.....	1	32	34	2 (prematures)
Multiparae.....	6	24	23	7

The third stage of labor in these patients was not attended with much difficulty. Only three patients had excessive bleeding, which was controlled without resort to transfusion. We have found the use of sand-bags and a binder placed on the abdomen immediately following the second stage a very valuable procedure to overcome the sudden decompression and circulatory pressure changes.

Reports have frequently been published to the effect that babies born to cardiac mothers have an average birth weight lower than the normal. Our figures do not agree with this. The average weights of the viable babies born to the primiparae was 7 pounds 9 ounces, and to the multiparae 7 pounds 11 ounces.

CESAREAN SECTIONS

Indications:
- Cardiac 6:
  - 3 primiparae: 5 class III; 1 class IIA. High degree mitral stenosis
  - 3 multiparae
- Obstet. 4:
  - 3 primiparae
  - 1 "repeat"

Total sections . . . 10

Anesthesia:
- Cardiac Indications: 2 G.O.E.; 2 Open ether; 1 Avertin, G.O.E.; 1 M.S. Scop. and Local
- Obstetrical Indications: 1 G. and E.; 1 Open ether; 1 Local, avertin, G.O.E.; 1 Spinal

Sterilization:
- 6 with cardiac indications.
- 3 with obstetrical indications.
- 1 with obstetrical indication who consented at second operation

There were ten cesarean sections done (9.1 per cent).

Carr and Hamilton[6] in a series of 500 pregnant women with heart disease report and incidence of approximately 20 per cent of cesarean sections. Fitzgerald,[2] on the other hand, in his series of 126 pregnant cardiacs, did not resort to section in any. However, the latter worker is affiliated with a city institution where he was able to hospitalize his patients as early and for as long a period as was necessary without expense to the patient. Thus he was able to carry the entire number of patients to term and delivery per vaginam without a single death. Carr and Hamilton[6] admit that it is not always possible to predict whether a given cardiac patient will have an easy or hard labor. Therefore they believe section is indicated in all cardiac patients who are considered by the internist to be bad prospects for prolonged labor, and in those who are definitely in failure. We are in accord with Daichman and Kornfeld[5] who conclude that "if labor threatens to be prolonged, if progressive toxemia is present or if there is any degree of disproportion, the case is best handled by section under local anesthesia."

As to the question of sterilization, we believe that any patient who is subjected to cesarean section or interruption of pregnancy for cardiac reasons should be sterilized, with one exception, namely, patients with active rheumatic fever whose pregnancies are interrupted because of the active infection, and who at a subsequent time may be able to bear children safely. However, sterilization per se should not be an indication for cesarean delivery.

Patients in the first trimester of gestation who are bad risks should have their pregnancies interrupted by the simplest procedure, such as dilatation and removal of the products of conception, and sterilization accomplished at a later date when the patient's condition permits and when the mortality rate is lower.

There were ten patients who had their pregnancies interrupted. Two were primiparae and eight multiparae. Four were done for prophylaxis and six for decompensation. These pregnancies ranged from six weeks to five months in duration.

Spontaneous premature labor is said to occur more frequently in cardiac than in non-cardiac patients. There were thirteen prematures born in our series. Labor had a spontaneous onset in eleven cases (7.3 per cent). In two cases, labor was induced for cardiac indications. Plass and Alvis,[7] in a statistical study of 129,539 unclassified births, report a premature incidence of 5.28 per cent.

FETAL MORTALITY

Uncorrected total—16 (10.4 per cent) (Includes all interrupted pregnancies).

2 full term stillbirths:
- 1 decompensated mother
- 1 high forceps delivery, decompensated mother.

2 prematures died shortly after birth: 14
- 2 pounds
- 3 pounds, ounces

2 died in utero with death of mother for congestive failure. Both in last month of gestation.

The fetal mortality is very high in women with heart disease, probably be-

cause the fetus is directly affected by the embarrassment of the maternal circulation. Death of the fetus in utero occurring in decompensated mothers furnishes evidence of this. Our uncorrected fetal mortality was 16, or 10.4 per cent. This includes ten pregnancies interrupted before the fifth month; two cases in which the fetus died in utero with death of the mothers from congestive failure, both in the last month of pregnancy; two premature babies (2 pounds and 3 pounds 14 ounces respectively) who died shortly after birth; and two full-term stillbirths (one from a decompensated mother and the other after a high forceps delivery, also from a decompensated mother).

That pregnancy actually produces severe strain on a diseased heart is shown by the number of patients who showed decompensation.

ANALYSIS OF CASES DECOMPENSATED EITHER DURING PREGNANCY OR LABOR

Number of patients.....26
Number of pregnancies.....31
(*a*) 21 decompensated before term.
(*b*) 9 decompensated at term or in labor.
(*c*) 1 not decompensated until second pregnancy (repeat section).

Management:
11 delivered by vaginal route at term.
6 delivered by section.
1 premature spontaneous labor.
2 premature labors induced by rupturing membranes (4 mos., 7 mos.)
7 interruptions of pregnancy by abdominal hysterotomy and sterilization.
1 interruption of pregnancy by dilatation and curettage.
2 died undelivered before term.

MATERNAL MORTALITY

8 deaths:
5 para 1 — 6 mitral stenosis.
2 para II — 1 congenital pulmonary stenosis.
1 para III — 1 fibrosis myocardium.

Management of cases:
3 vaginal delivery at term.
1 died on delivery table, undelivered, at term.
1 cesarean section at term.
1 abdominal hysterotomy and sterilization in pregnancy.
2 died in pregnancy—8 and 8½ months.

Analysis of prenatal care in patients who died:
2 followed in Clinic. Admitted at term Class 1. Decompensated in labor.
1 followed in Clinic. Admitted at term decompensated.
5 admitted to hospital decompensated at first visit to clinic during pregnancy.

Heart disease takes its stand among the leading causes of maternal mortality. The majority of reports in the literature reveal a 5 to 10 per cent death rate. Eight patients died in our group, an uncorrected mortality of 7 per cent. Five of these patients had no prenatal care. Fitzgerald's[2] comparative study serves well to illustrate the value of prenatal supervision of the cardiac. He had no deaths in a series of 126 women with heart disease whom he followed from early pregnancy through delivery. He accomplished this by careful supervision and hospitalization of every patient who showed the slightest degree of lowered cardiac reserve. During the time that this group was under observation, there were seventy-nine patients with heart disease who were admitted to the same hospital in congestive failure, as emergencies, never having had any prenatal care. Twenty-one of these women died. Carr and Hamilton[6] noted that in private practice no deaths had occurred thus far among patients under strict medical and obstetrical control from early in pregnancy or before pregnancy.

CONCLUSIONS

We found that the average length of labor in the cardiac patient was not appreciably different from that in the non-cardiac.

The incidence of operative interference was higher in order to shorten the second stage.

Open ether was the anesthetic of choice for delivery.

The average weight of the babies born to cardiac mothers was slightly above the average normal.

The incidence of spontaneous premature labor was slightly higher. There were 23.6 per cent of the patients in this series who were decompensated either in pregnancy or during labor.

The fetal mortality was 10.4 per cent (uncorrected).

Eight mothers died, an uncorrected incidence of 7 per cent. Five of these patients had no prenatal care.

The pregnant cardiac patient is best managed through pregnancy and labor by the joint efforts of the internist and obstetrician.

REFERENCES

1. Reis, R. A., and Frankenthal, L. E. Jr. *Am. J. Obst. & Gynec.*, 29: 44, 1935.
2. Fitzgerald, J. E. *Am. J. Obst. & Gynec.*, 29: 53, 1935.
3. Schuman, W. *Am. J. Obst. & Gynec.*, 29: 64, 1935.
4. Scott, W. A., and Henderson, D. N. *Am. J. Obst. & Gynec.*, 27: 342, 1934.
5. Daichman, I., and Kornfeld, G. *Am. J. Obst. & Gynec.*, 30: 386, 1935.
6. Carr, B. F., and Hamilton, B. E. *Am. J. Obst. & Gynec.*, 26: 825, 1933.
7. Plass, E. D., and Alvis, H. J. Yearbook of Obstetrics and Gynecology. Chicago, 1934. De Lee & Greenhill.
8. Greenhill, J. P. *J. A. M. A.*, 102: 28, 1934.
9. Stander, H. J. *Am. J. Obst. & Gynec.*, 27: 528, 1934.
10. Sabel, M. *Am. J. Obst. & Gynec.*, 26: 417, 1933.

Our grandfathers were family physicians, practicing family medicine, which is the most human type of medical practice the world has ever known.

From—"Disease and the Man" by Roger F. Lapham (Oxford).

ADVANCES IN RAPID TISSUE SECTION METHODS*

AN EVALUATION OF MORE RECENTLY DEVELOPED TECHNIQUES

W. E. B. HALL, M.D.

Pathologist, State Hospital No. 2; Associate Pathologist, St. Joseph's and Missouri Methodist Hospitals

ST. JOSEPH, MISSOURI

THE pathologist presented with a tissue at the operating table is faced with two serious problems in returning a diagnosis to the waiting surgeon. Only by careful preparation and subsequent study of his rapidly sectioned material can he return an eminently satisfactory and trustworthy report. This takes time, time that is valuable to the waiting surgeon and unconscious patient, but the diagnostic skill of the best of pathologists is wasted on hurried and slipshod methods of preparation of rapid tissues. The conscientious surgeon realizes the necessity of this time interval and looks askance on a hastened pathologic report.

The pathologist today usually relies on variations of multiple stain or polychrome frozen section techniques. As a rule, an interval of ten minutes is considered a minimal diagnostic average. With the increasing importance of cancer diagnosis and therapy, and the necessity of a prompt and careful diagnosis in early lesions, the pathologist has added three important differential procedures. These are (1) the Terry technique of supravital staining with its various modifications; (2) the nuclear-nucleolar ratio variabilities of the malignant cell as presented by MacCarty; and (3) the vital staining of wet film tissues by a microscopic modification of the Schiller test as prepared by Dudgeon and Patrick.

TERRY SUPRAVITAL TECHNIQUE

First introduced by Wilson in 1905, and later by MacCarty of the Mayo Clinic, the method of sectioning fresh tissue by the microtome after freezing, and subsequently staining by polychrome methylene blue, is now in almost universal use. This method has been regarded with question by such men as Ewing, Sternberg and Warthin. The necessity for a more satisfactory procedure, less expensive, and of a type that could be readily performed in the operating room, led to the perfection of Terry's supravital technique.

This method consisted essentially of preparation of thin slices of a tissue, superficially stained in a fresh state by polychrome methylene blue, and after covering with a cover slip, examination by transmitted light. Terry found 96 per cent of 2,000 tissues examined by this method agreeing with microtome diagnoses. Hellwig, in 1935, presented his modification of Terry's method, and reported himself highly enthusiastic as the result of his examination of 1,030 biopsies, 303 of them malignant. Complete agreement between histologic diagnoses obtained by Terry tissue and later paraffin sections was noted in 93.1 per cent, while malignancy and benignancy were recognized correctly in 96.6 per cent of the Terry sections.

The technique, as outlined by Hellwig, consists of: (1) fixation of the questioned tissue to a plate of cork by two upright pins; (2) sectioning off of a thin slice of tissue by a sharp biconcave razor or safety razor blade, the section running parallel to the upright pins; (3) covering the tissue, placed on a glass slide, with polychrome methylene blue for one to three seconds; (4) washing off the excess of stain carefully with tap water and covering the surface firmly with a glass cover slip. The tissue is

* Based on a twelve-month study in the Department of Pathology and Tumor Clinic of State Hospital No. 2, and of the Missouri Methodist Hospital, St. Joseph Missouri.

then examined by transmitted light, using a 60 watt Mazda bulb for ordinary tissue, and an arc light for thicker, darker or bloody tissue. One advantage of this method is that all tissue may later be placed in 10 per cent formalin for paraffin preparation. By frozen section methods, all superficial tissue removed by the microtome is permanently lost, as the sectioned fragments do not present satisfactory paraffin material. By the Terry technique, tissues are presented in a form dissimilar to that found in permanent tissue sections. Particularly is the cell form altered, while staining characteristics assume unusual variations; weird and indescribably beautiful tissue pictures are presented to the eye. These start to fade in six to eight minutes, cell outline and cytoplasm disappearing first, leaving a pale, outlined nucleus with deeply staining nucleoli, which persist for a long time like black beads on a pale greenish-blue background. Most diagnostic difficulties are encountered in round-cell tissues.

Constant use of the Terry technique for rapid diagnosis in our tumor clinics led to certain modifications. Only fresh polychrome methylene blue, which gives a highly differential reddish-orange and blue-green stain, is used. This, we find, must be applied for upwards of twenty-five seconds to the tissue surface, and allowed to drain off before the cover slip is applied. Tap water is rarely used to remove the stain, as the differentiation is usually lost and the intensity and clarity of staining are diminished. The Terry method of examination has been found unsatisfactory in very soft or fragmented tissue, particularly curettings. This objection is also encountered in frozen sections, where suspected fragments must be examined singly.

A modification evolved in the tumor clinic allows examination of a whole mass of curettement fragments, as well as the softest of tissues. For this modification, two cover slips are firmly fixed by balsam to either end of a glass slide, and a small mass of flattened out curettings or crudely sectioned pieces of friable or soft tissue are then placed in the intervening depressed area. One or two drops of tap water are applied to the tissue or beneath it to allow a complete fluid contact between glass slide and tissue. The slide is then turned over and, if the tissue to be examined is properly but not too greatly moistened, it will adhere to the under surface or may be held in place by light counter-pressure with a tongue depressor. The upper surface of the glass slide is sprayed with ethyl chloride, freezing the underlying tissue, which is then shaved flat by gentle strokes of a sharp, flat-surfaced razor or preferably a safety razor blade, to a thickness of 0.1 to 0.2 cm. If required, freezing is promptly repeated. The tissue is then allowed to thaw, polychrome methylene blue is applied for fifteen to twenty-five seconds, drained off, and a cover slip placed horizontally on the tissue, which is examined by transmitted light of a 60 watt Mazda bulb or stronger illumination as required. By this method, whole masses of curettings are examined, presenting a picture not unlike that in permanent paraffin sections.

THE NUCLEAR-NUCLEOLAR RATIO OF THE MALIGNANT CELL

MacCarty as a result of consistent examination and comparison of the nucleoli of malignant, benign, and reparative cells, arrived at the conclusion that the nucleoli of malignant cells presented a certain area ratio characteristic which would serve to identify malignancies, even in the earliest stages. This followed closely on his observation that the granules of normal regenerative cells were smaller than those of malignant cells. In 1907, he made the observation that unfixed unembedded fresh surgical tissues with and without stains were quite different from the ordinary prepared tissue. The cancer cell did not assume the ordinary bizarre forms, and even the mitotic figures were usually of regular form. Living cells, including particularly the cancer cell, were usually oval

or round, poorly defined, the nucleus very pale, while the nucleolus, so frequently lost in the permanent tissues, stood out prominently. Working on tissue prepared by frozen section method, both fresh and formalin-fixed, as well as on supravitally stained tissue, it was noted that the nucleolus of the malignant cell is much larger compared with the size of the nucleus, than is the nucleolus of the benign or reparative cell. The summary of the measurements and ratios determined by a number of workers shows that the ratio of the nucleus to nucleolus, measured on the basis of the area in squares of microns, was from 14:1 to 36:1 for regenerative and benign cells, while the ratio for malignant cells was between 7:1 and 26:1. There is usually a set ratio of nucleus to nucleolus for every particular organ and tissue cell whether of the benign or the malignant type. Thus in the case of breast, Haumeder found the ratio was 17:1 in benign conditions, and 11:1 in malignancies. Working on ovarian tumors, of which forty-nine were benign and thirty-three malignant, MacCarty showed that the ratio area of the malignant cell nucleus to the non-malignant cell nucleus was 1.35:1, while the ratio area of the malignant cell nucleolus to the non-malignant nucleolus was 3.9:1. Further, the nuclear-nucleolar ratio decreased with an increase in the grade of malignancy, while the nuclear-nucleolar ratio of malignant ovarian cells was less than one-third of the non-malignant.

This method of identification and determination of the presence of malignant change has not proved satisfactory, particularly for operating room rapid tissue diagnoses. Wide variability in the size of the nucleolus in the prepared tissue has not been found to be a reliable diagnostic criterion of malignancy. Considerable variability, as much as four to one, has been noted in the nucleoli of degenerative, inflammatory, and reparative tissues, many of them used as controls. This factor, when present, has not been sufficient to warrant the presentation of a diagnosis of malignant change to the operative surgeon, where the general microscopic picture has created uncertainty as to the true interpretation. Taken with other features which tend to indicate malignant change, such as mitotic figures, and variability of cell arrangement and distribution in the fresh section, the exposition of wide nucleolar ratio variation may be used as assisting in the confirmation of malignant change. Its absence has been frequently noted in malignancies, particularly of low-grade type, and has been noted particularly in new growths of the cervix.

A patient with giant cell tumor of the tendon fascial sheath, undergoing fibromyxosarcomatous change as interpreted by permanent paraffin differential stains, returned to the hospital ten months later for a recurrence. Tissues excised at the second operative excision were examined by fresh Terry and frozen techniques, as well as permanent paraffin sections. The fresh sections showed variability in cell size and form, occasional mitotic figures in large cells, marked cell nuclear and nucleolar variability in size, along with bird's eye inclusions, while the nucleoli appeared as a rule markedly bizarre in form, variable in size, often multiple, with six to eight nucleoli sometimes appearing in a single nucleus, and with a ratio variability of the nucleoli as high as 1:8. Likewise, there was high variability in the nuclear-nucleolar ratio of various cells. Although giant cell tumors of tendon and fascial sheaths are supposed to be invariably benign and incapable of malignant change, a diagnosis of true malignant change was made on this recurring tumor, on the strength of the diagnostic nuclear-nucleolar characteristics of malignant cells as brought out by MacCarty.

MICROMODIFICATION OF THE SCHILLER TEST

The Schiller test, consisting of the application of Lugol's or preferably Gram's iodine to the cervix, has been an important new additional diagnostic procedure. Based

on the fixation and combination of iodine with granules of glycogen in normal living squamous cells of the cervix, this test delineates areas of the cervix which have undergone abnormal change and should be examined. It is not solely diagnostic of malignancy, as other pathologic processes may leave unstained areas to the cervix.

Dudgeon and Patrick have applied this method to a microscopic technique whereby small superficial fragments from suspicious areas are removed, teased out in a moist medium, preferably of the iodine solution of Gram or Lugol. By this method, nuclei appear with fair definition and normal cells are supposed to stand out prominently and clearly with sharply outlined cell margins, whereas the malignant cells displaying a variability of size, shape, and distribution, completely lose their cell outline and refuse the iodine stain. Several authors have commented favorably on this method, but its application in our tumor clinics has not been satisfactory. This is based on the fact that other nuclei take some iodine stain, producing a malignant-like picture, and the iodine tends to precipitate in tissues of watery content. Other differential stains cannot be used since they precipitate the iodine. All cells other than normal squamous epithelium refuse to take the sharply defined iodine stain, and even this is lost after the menopause. A diagnosis of malignancy should not be made on such a negative finding. No case suspected of malignancy should be differentiated by such a faulty method, nor is time so precious that a small biopsy section of the suspected area, as demonstrated by the Schiller test, cannot be made and a prompt report returned by the Terry or frozen section methods, confirmed by permanent paraffin sections. The method, however, is an interesting supplementary procedure.

SUMMARY

Three new diagnostic procedures are available to the pathologist for rapid section operating room diagnosis. These are the Terry supravital technique, the nuclear-nucleolar ratio variabilities of the malignant cell, as demonstrated by MacCarty, and the microscopic vital-stained modification of the Schiller test.

The Terry technique has been found highly satisfactory, except in soft and fragmented tissues for which a modified technique is presented. MacCarty's ratio variabilities have not been found diagnostic or differential, but have been used as confirmatory characteristics. The micro-modification of the Schiller test has been found to be a variable procedure, limited in its application, dangerous in its potentialities, and should be replaced by prompt rapid section techniques on tissues removed for biopsy examination from areas demonstrated by the Schiller test.

REFERENCES

Terry, B. T. A new and rapid method of examining tissue microscopically for malignancy. *J. Lab. & Clin. Med.*, 13: 550, 1928.

Terry, B. T. Improvement in technic and results made in examining microscopically by the razor section method 2,000 malignant tissues. *J. Lab. & Clin. Med.*, 14: 519, 1929.

Wilson, L. B. A method for the rapid preparation of fresh tissues for the microscope. *J. A. M. A.*, 45: 1737, 1905.

Hellwig, C. A. Tissue diagnosis during operation. *Surg., Gynec. & Obst.*, 61: 494–498 (Oct.) 1935.

MacCarty, W. C. The early diagnosis of cancer. *Arch. Clin. Cancer Research*, 1: 11–20, 1935.

MacCarty, W. C. The cancer cell and nature's defensive mechanism. *Surg., Gynec. & Obst.*, 41: 783–793 (Dec.) 1925.

MacCarty, W. C. Identification of the cancer cell. *J. A. M. A.*, 107: 844 (Sept. 12) 1936.

Page, R. C., and MacCarty, W. C. Cytology of ovarian tumors. *Arch. Path.*, 24: 1–7 (July) 1937.

Schiller, W. Early diagnosis of carcinoma of the cervix. *Surg., Gynec. & Obst.*, 56: 210, 1933.

Dudgeon, L. S., and Patrick, C. V. A new method for the rapid microscopical diagnosis of tumors, with an account of 200 cases so examined. *Brit. J. Surg.*, 15: 250, 1927.

Dudgeon, L. S., and Barrett, N. R. The examination of fresh tissues by the wet-film method. *Brit. J. Surg.*, 21: 85, 1934.

Bowes, R. K., and Barrett, N. R. The use of vital staining and wet films in the diagnosis of lesions of the cervix. *Surg., Gynec. & Obst.*, 60: 1072, 1935.

EXPERIMENTAL INVESTIGATION OF EVISCERATION

ISIDOR KROSS, M.D., F.A.C.S.

Surgeon, City Hospital; and Associate Surgeon, Beth Israel and Montefiore Hospitals

NEW YORK CITY

IN a recent investigation[1] the author made a clinical study of postoperative evisceration in which the various theories of the mechanism of its production were presented and analyzed. As a result of his findings, the following conclusions were made: " . . . no one single factor by itself is solely responsible for all cases of evisceration . . . this condition is one brought on by a combination of events, in which any single one may by itself be insufficient, but which combined with others may produce wound rupture. The results of the experiments of Freeman, King and the author, and the frequent findings of a partial wound rupture with healing of the rest of the wound, justify the assumption that, in all probability, the one most important factor is a defect in the closure of the peritoneum."

To test this hypothesis the following experiments were carried out in the pathology laboratory of the Beth Israel Hospital (Dr. A. Plaut, Director).

Adult rabbits were used for these experiments. Under nembutal anesthesia, and using the customary operating room aseptic technique, an abdominal incision about 1½ to 2 inches long was made transversely in some and longitudinally in others. The wound was now closed. Silk was used for suture material. The peritoneum and muscles were closed in a single layer and the skin edges united with a second layer of sutures. In some animals (see protocols) one angle of the wound for a distance of about 0.5 cm. was left open. In others the wound was sutured loosely so that the

TABLE I

Number of operations	16
Definite evisceration	6 (37½ per cent)
Adhesion to abdominal scar	7 (43¾ per cent)
Negative findings	3 (18¾ per cent)

TABLE II

PROCTOCOLS

Rabbit	Duration of Experiment, Days	Date of Operation	Sacrificed	Result
#62	4	11/12/36 Upper angle left open.	11/16/36 Found dead	Upper angle filled with loop of large intestine.
#64	2	11/14/36 Upper angle left open.	11/16/36	Definite mass of intestine in upper part of wound, size of walnut.
#75	4	11/12/36	12/17/36	Large bowel adherent to scar.
#71	2	11/14/36 Upper angle left open.	11/16/36	Large gut found prolapsed within opening and tightly impacted.
#65	2	8/ 8/36 Upper angle left open.	8/12/36	Small intestine and omentum in wound.
#80	36	12/ 2/36 Transverse incision—right angle left open.	1/ 7/37	Wound well healed.
#81	32	12/ 3/36 Transverse incision—right angle left open	1/ 4/37	Mass size of walnut found in right angle of incision. Small intestine and omentum found in right angle.
#100	4	12/25/36 Transverse incision—sutured loosely.	12/29/36	Large bowel loop adherent to peritoneum at site of loose suture.
#35	13	12/31/36 Lower angle open, rest sutured loosely.	1/13/37	Small intestine densely adherent to wound.
#36	18	12/31/36 Lower angle open, rest sutured loosely.	1/18/37	Omentum adherent to upper wound.
#40	24	1/ 7/37 Transverse incision—sutured loosely.	2/ 1/37	Omentum tightly adherent to lower angle of wound.
#41	8	1/ 8/37 Sutured loosely. Transverse incision.	1/16/37	Omentum and small intestine adherent to wound.
#42	3	1/11/37 Transverse incision—sutured loosely.	1/14/37	Wound firmly healed —no adhesion.
#43	20	1/11/37 Longitudinal incision—sutured loosely.	2/ 1/37	Omentum adherent to lower angle of wound.
#58	5	1/29/37 Sutured loosely.	2/ 3/37	Lower angle open. No adhesion found.
#39	3	10/20/36 Upper angle open.	10/23/36	Definite mass found in upper angle. Reducible about 1 inch in diameter.

peritoneum was not approximated accurately, thus attempting to simulate the closure in the human when the patient was straining and when small tears of the peritoneum would occur. The animals were sacrificed at intervals varying from two to thirty-six days, and the abdominal wall was examined after it had been incised circumferentially at a considerable distance from the original incision in order to avoid any disturbance of the findings at the site of operation. The results are shown in Table 1.

In six animals there was found within the abdominal wall a definite gap into which the intestine had prolapsed and which had thus formed a definite evisceration. In seven instances the findings consisted of firm adhesions of omentum or intestine or both, to the scar of the abdominal incision, which had, however, closed completely. In the remaining three cases no abnormal status obtained. From these findings it is to be noted that at times the abdominal wound, in spite of the deliberately formed openings, closed completely before any of the abdominal viscera could find their way in and even before any adhesions could be formed. On the other hand, in most instances (81 per cent) the abdominal viscera either attached themselves to the opening or actually found their way into it and thus produced definite evisceration or firm postoperative adhesion with the scar. These experimental findings are in accord with the clinical findings of E. S. F. King[2] in his investigation of postoperative hernia.

CONCLUSION

It seems quite reasonable to maintain that postoperative adhesion to the abdominal scar, postoperative incisional hernia, and postoperative evisceration are differences in degree only of the same pathologic phenomenon, and are due in all probability to the same factor: incomplete union of the peritoneum following inadequate closure.

REFERENCES

1. Kross, I. *Am. J. Surg.*, 39: 610, 1938.
2. King, E. S. F. *Brit. J. Surg.*, 23: 35, 1935.

CASE REPORTS

SURGICAL TREATMENT OF CHYLOUS MESENTERIC CYST BY MARSUPIALIZATION*

MORRIS A. SLOCUM, M.D., F.A.C.S.

Attending Surgeon, St. Margaret Memorial Hospital

PITTSBURGH, PENNSYLVANIA

OF all abdominal tumors, those found in the mesentery are said to be the rarest. Cysts of the mesentery are encountered so seldom as to make them surgical curiosities. Certain features of especial interest centering around mesenteric cysts, in addition to their rarity, are their etiology, disputed classification, infrequency of preoperative diagnosis, variability of symptomatology, and the part they play in the production of intestinal obstruction.

History. First mention of a mesenteric cyst goes back to 1507, when a Florentine anatomist, Benevieni, described one found at autopsy. From this time up to 1850, record is found of a few cases encountered accidently at operation or autopsy. No patients operated on, however, recovered. In 1803, Portal classified all the reported cases, and in the year 1842, Rokitansky published the first accurate description of chylous mesenteric cysts found at autopsy.

The earliest record of a successful cure of a mesenteric tumor was in 1880, by Tillaux. Three years later, Pean reported the recovery of a patient with a chylous cyst treated by marsupialization. It was not until 1900, however, when Dowd[1] published his classic paper in which he put forth his classification of mesenteric cysts, that surgeons began to show an active interest in this subject.

Prior to 1900, a total of 145 cases had been described in the literature. Because of the fact that in a considerable number of reports accurate description of the tumor was lacking, the ratio between solid and cystic tumors cannot be determined. Since Dowd's original paper, an increasing number of case reports have appeared in the literature. It would seem that no more than 300 cases of true mesenteric cyst are on record, and this number includes many reports of very small cysts of little importance or interest clinically. Careful and prolonged review of the literature fails to reveal the exact number of true chylous mesenteric cysts, and especially those of sufficient size to produce either symptoms or complications. Of such cases there would seem to be no more than 200 at the most.

In the most recent report on this subject, published by Roller,[2] it is stated that probably 500 cases of mesenteric cysts have been recorded in the literature. Of this number, it is not possible to discover how many are of the chylous variety. Roller did mention, however, that in his clinic the ratio of mesenteric cyst was less than one in every 100,000 abdominal operations, and of mesenteric tumors, one in some 35,000 cases.

The Massachusetts General Hospital has a record of only six cases in the years from 1900 to 1926. The records of the University of California Hospital since 1906 reveal but one case of cyst and one of tumor of the mesentery in 93,511 admissions. The Chil-

* From the Department of Surgery and John C. Oliver Research Foundation, St. Margaret Memorial Hospital, Pittsburgh, Pennsylvania.

drens' Hospital in Los Angeles in a recent three and one-half year period found three cases in 12,425 admissions. Since 1930, the Los Angeles General Hospital has had but one case of mesenteric cyst in 188,921 admissions. The New Harborview Hospital of Seattle reported that in a survey of 27,000 admissions no cases could be found. Judd and Heimdal[3] stated, in 1929, that out of 820,000 admissions to the Mayo Clinic, twenty-five cases of mesenteric tumor were encountered, of which eight were cystic.

Numerous other observers have commented upon the infrequency of such cysts, and therefore the report of a case seemed justifiable.

Etiology and Classification. There is little or no unanimity of opinion as to the true genesis of these cysts. It is evident from careful scrutiny of the literature that from the earliest reports to those of today, investigators have devoted much time and speculation to this aspect of the subject. So many theories have been advanced that to attempt to summarize them in one paper would be not only confusing, but burdensome to the reader. Warfield,[4] in a fairly recent paper, lists the causes of mesenteric cysts as follows:

1. Embryonic retroperitoneal organs, as germinal epithelium, ovary, Wolffian or Muellerian bodies.
2. Displaced embryonal intestinal tissue.
3. Dermal inclusions.
4. Angiomas of blood and lymph vessels.
5. Parasitic or bacterial infection.
6. Necrosis of lymph nodes or solid tumors, as tuberculosis, lipomata, malignant tumors.
7. Trauma or foreign bodies.
8. Lymphatic obstruction.

In a more recent paper, Eliason and North[5] quote a number of writers whose theories are widely divergent. Dowd,[1] in his classic paper, classified true embryonic or sequestration cysts according to their contents. Higgins and Lloyd later established a distinction between cysts whose walls were of: (a) mesodermal origin, arising from remnants incarcerated behind the peritoneum and migrating forward between the leaves of the mesentery; and (b) intestinal origin, developing from diverticula, or from persistent portions of the Vitelline duct. In the former group, the tissue found in the cyst wall is not differentiated in layers, and contents may be chylous, hemorrhagic, or dermoid. Many observers now feel that the contents of true mesenteric cysts are merely an accidental occurrence, and bear no relationship to genesis of the cyst.

It can be seen from the foregoing that all attempts to explain the etiology and to establish an acceptable classification have been unsatisfactory. It is felt that until further research into the subject brings to light the true cause of these cysts, it would be better for the sake of accuracy to include in the classification of true mesenteric cysts only those that are found to be between the leaves of the mesentery. In reviewing the literature, it is clear that many cases reported as cysts do not belong in that category.

Mesenteric cysts have been found in the fetus and in patients as old as eighty. The fourth decade is the period when they are most commonly found. Women develop these cysts about twice as often as men.

Location. Mesenteric cysts have been found from the duodenum to the rectum. Over one-half of the cases occur in the small bowel mesentery, and of these, one-quarter in the mesentery of the ileum.

Pathology. Most cysts of the mesentery are single. Their size may vary from those too small to palpate to those large enough to fill the entire abdomen. About half are multilocular. The cyst wall is usually thin and lined with epithelial cells. When the cyst is very large, the wall is usually so thinned out by the pressure of its contents that its epithelial lining is lost and the wall is composed of fibrous tissue elements only. Malignant degeneration is rare. If it occurs, it may be either carcinoma or sarcoma. The contents may be chyle, as in the case herein reported, serous fluid, clear or cloudy, or blood. The contents are

always sterile unless the cyst causes intestinal obstruction. Spontaneous rupture of cysts has been reported.

together with the symptoms of acute appendicitis, led to the diagnosis later confirmed at operation.

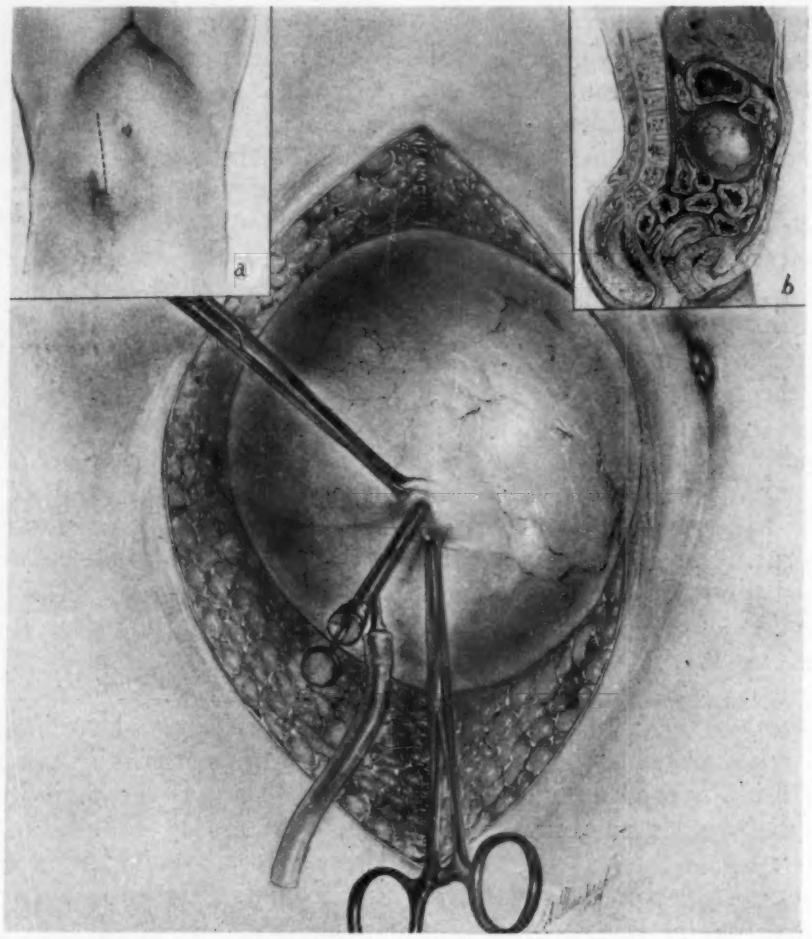


Fig. 1. Shows the cyst held into the wound by clamps, and the trocar and the cannula in the cyst preparatory to aspiration of its contents. Insert *a*, the patient's position on the table and the location of the incision; *b*, the relation of the cyst.

Symptomatology. If the cyst is large enough to be palpated, the diagnosis should not be difficult. However, most writers stress the fact that an accurate preoperative diagnosis has seldom, if ever, been made. Judd and Heimdal,[3] in 1929, reported eleven cases of mesenteric cyst, two of which were definitely diagnosed before operation. Hueper[7] reported one case in a child where he, before operation, made the diagnosis of acute appendicitis and mesenteric cyst. He had been able to palpate a mass the size of an egg in the region of the appendix, and this finding,

There are no symptoms which are pathognomonic of mesenteric cysts. In fact, many cysts produce no symptoms whatsoever. Pain, variable in degree, is the most constant symptom. Occasional episodes of pain with vomiting may occur. Many reports contain mention of the presence of fatigability. One might account for this on the basis of the cyst exerting a constant pull on the mesentery. In cysts of considerable size, pressure upon other organs produces symptoms peculiar to such organs, such as the urinary bladder, pelvic viscera, kidneys, and so forth. Alternating

attacks of constipation and diarrhea may occur. Impairment of the appetite may follow pressure upon the stomach itself. From the foregoing, one is impressed by the vagueness of the symptoms. Unfortunately, and too frequently, the first warning that a cyst is present is the onset of a complication, such as intestinal obstruction.

The physical findings, however, offer a much better basis for accurate diagnosis. A round, smooth mass of cystic consistency, freely movable, especially from side to side, should strongly suggest mesenteric cyst. Moving the cyst is seldom a painful procedure. Percussion will reveal a flat note, unless there is a loop of adherent bowel when a band of tympany may be elicited. Little can be expected in the way of help from the *x*-ray, other than proof by barium studies that the mass is not in the lumen of the bowel itself.

Diagnosis. Mesenteric cysts must be differentiated from the following pathologic conditions: (1) ovarian cyst; (2) retroperitoneal tumor; (3) pancreatic cyst; (4) neoplasm of the bowel; (5) pedunculated fibroids of the uterus; (6) movable kidney; (7) hydronephrosis; (8) hydrops of the gall-bladder; (9) omental cyst; (10) tuberculous abscess; (11) pregnancy; and (12) splenic tumor.

While any of the above disorders could simulate a mesenteric cyst, it is believed that if this rather rare condition is kept in mind when examining a patient with a palpable tumor, the diagnosis should not be so difficult as a perusal of the literature would indicate.

Complications. By far the most frequest complicating condition is that of intestinal obstruction. Volvulus, causing obstruction, is often initiated by a tumor of the mesentery. Adhesions of the bowel to the cyst commonly produce obstructing symptoms. Pressure of a very large cyst, especially when impacted in the pelvis, can bring about obstruction through pressure upon the intestine. Rupture of these cysts is rare, but has been reported, and will cause violent peritoneal irritation leading on to diffuse peritonitis. Massive hemorrhage into a cyst does occur. As mentioned before, the onset of complications very often leads to the discovery of an entirely unsuspected mesenteric cyst.

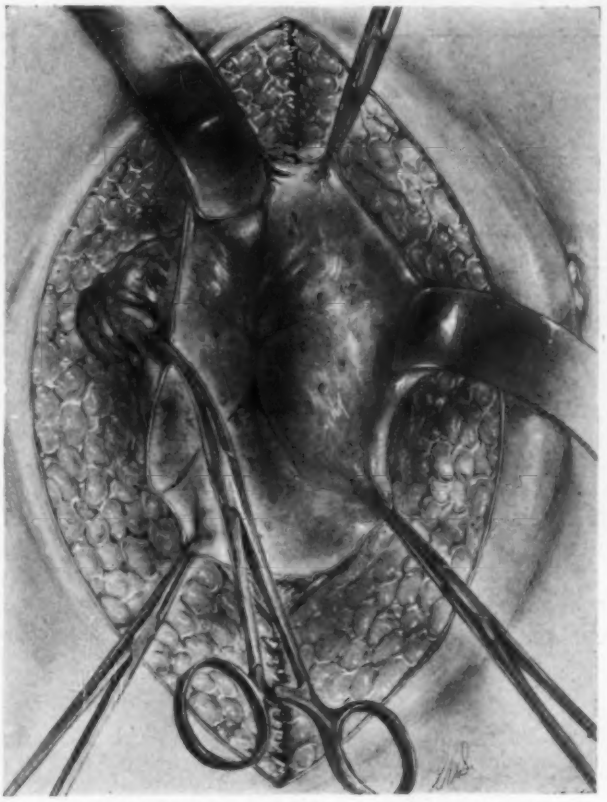


Fig. 2. The cyst is shown widely open, after the contents have been evacuated. Note the densely attached loop of the small bowel above and to the left.

Treatment. There is by no means universal agreement on this subject on the part of surgeons writing about or reporting cases of mesenteric cyst. It is interesting to note that in the early days of abdominal surgery, these cysts were usually aspirated or marsupialized. Attempts to remove them entirely carried an appalling mortality. Gradually, as cases were reported in the literature, one notes a definite trend toward enucleation as the method of choice.

No mention can be found anywhere in the literature of an effort to separate cases in which the cyst was operated upon per se and from those which were operated upon because of complications, such as bowel obstruction. In other words, the various accepted procedures indicated in the first

group are often distinctly contraindicated in the second.

A number of surgeons strongly denounce the procedure of marsupialization as antiquated, whereas others highly favor the method, emphasizing its low mortality and its permanency of cure.

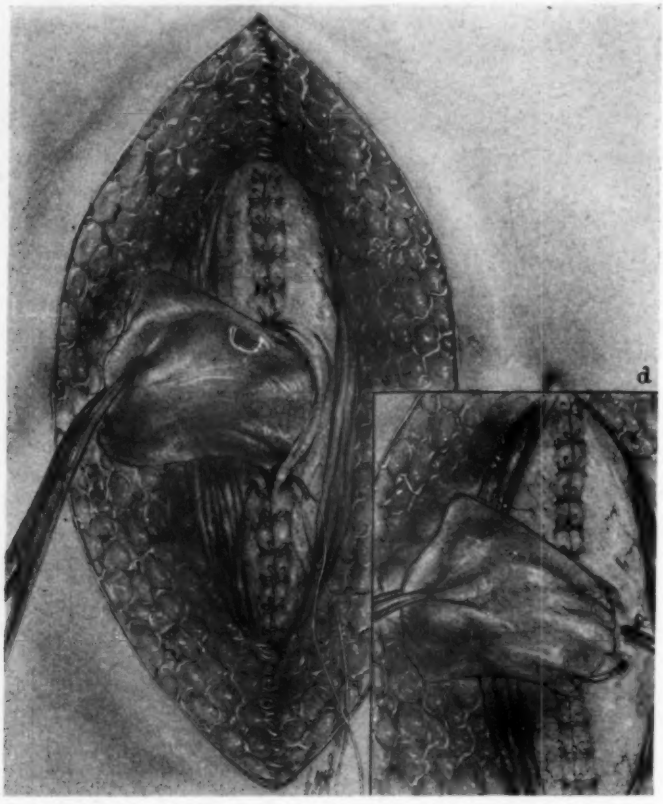


FIG. 3. The peritoneum has been closed above and below the cyst, and a suture is seen attaching the cyst wall to it. The cyst was held out of the wound as far as possible. The rectus sheath closed firmly up to the cyst.

No outline of treatment will be given in the group of cases where the complicating factor is the predominant condition to be coped with. Here the judgment of the surgeon must be his guide. It would seem scarcely necessary to refer to the well-known modern procedures resorted to in the surgical attack upon intestinal obstruction, wherein as little operating as possible is indicated.

In dealing with an uncomplicated cyst, it is the consensus of surgical opinion that the following procedures are to be followed in the order of their importance: (1) enucleation; (2) excision with resection of adherent bowel if necessary; (3) marsupialization; and (4) aspiration.

Many reporters classify the treatment as to safety only, while others stress the factor of permanence of cure. Certainly each case must be a law unto itself. The operative technique can be determined only when the cyst is exposed. However, when possible, complete enucleation is the method of choice. When adherent bowel is encountered, the decision as to what to do is most important and would be influenced by such factors as the general condition of the patient, obesity, and the skill of the surgeon. There is no escaping the fact that bowel resection with anastomosis carries a definite mortality factor, especially when added to the excision of a large cyst. Upon the other hand, simple marsupialization offers the safest method by

far. Its disadvantage lies solely in the possibility of a persistent sinus, or perhaps recurrence. It is here that a strong plea should be made to surgeons to give this method greater consideration when confronted with the problem as to whether or not to resect. The technique described in this paper claims no originality. However, careful observance of the technical details outlined would carry a promise of permanent cure with maximum safety and should deserve the respect of all. The literature contains no mention of a death following marsupialization, whereas enucleation and excision with resection show rates as high as 40 per cent in reports published since 1910.

Marsupialization was first done successfully in 1883, by Pean. Warfield[4] states that this method has a very definite place in the treatment of these cysts, especially when there is adherent bowel and where the cyst is very large. Collins and Berdez,[8] in a recent article, state that in reviewing the literature they found that marsupialization has resulted in the largest number of recoveries. It has been impossible to estimate the proportion of recurrences of sinus formation following this procedure, as no mention of this fact can be found in the literature.

Aspiration is to be resorted to only as a diagnostic measure and has no curative value.

CONCLUSIONS

1. Mesenteric cysts, especially the chylous type, are fairly rare.

2. The genesis of these cysts is not entirely clear, and further investigation is needed.

3. Early recognition and removal is important in order to avoid the much more serious complications.

4. Mesenteric cysts should be more often considered when attempting to make differential diagnosis of abdominal tumors.

5. The treatment is entirely surgical. Complete extirpation is the treatment of choice, but cannot always be done with safety. A plea is made to give the procedure of marsupialization its proper place in the accepted forms of modern treatment.

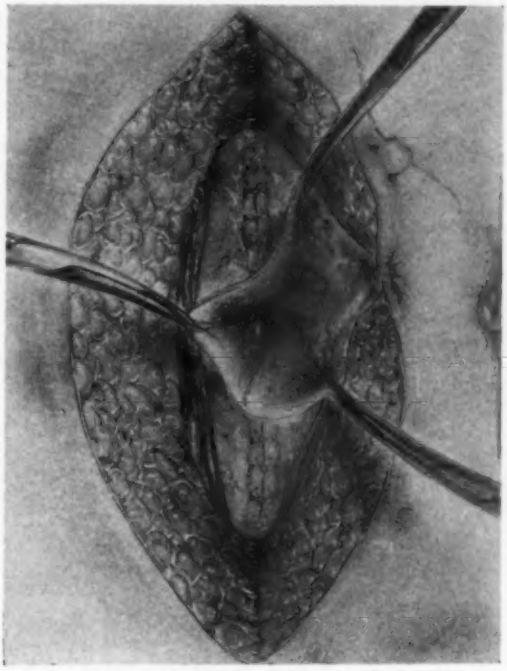


Fig. 4. The edges of the opened cyst sutured to the skin, using interrupted silkworm gut.

6. Marsupialization is stressed as a simple and safe treatment, carrying almost no mortality and with few disadvantages.

7. Although no extensive generalizations may be drawn from the chemical analysis reported in this paper, due to the lack of consistent normal data, the figures reported suggest the composition of somewhat dehydrated chyle. Previous observations of the bacteriostatic properties of chylous fluids are confirmed. Because there is little reference to chemical analyses of cyst contents in the literature, the chemical report found in this paper is of especial interest.

REPORT OF CASE

Miss M. D., age 48 years, was admitted to St. Margaret Memorial Hospital December 30, 1935. The chief complaint at this time was irregular and profuse menstrual periods during the past year. In addition, she was bothered with dyspnea on exertion and a gradual increase in the size of the abdomen, which, she thought, began about four years previous. At no time

was any regression in the size of the abdomen noted. Early in 1933, the patient began to experience a sense of dull discomfort across the upper abdomen, made more noticeable by being jarred, or by having some one bump into her chair. Ten days prior to admission, she was seized with an attack of severe abdominal pain, worse in the left hypochondrium. The pain was continuous, accompanied by slight nausea but no vomiting, and lasted four days. The pain was described as sharp and cutting and made worse by coughing. A physician was consulted and advised her to enter the hospital.

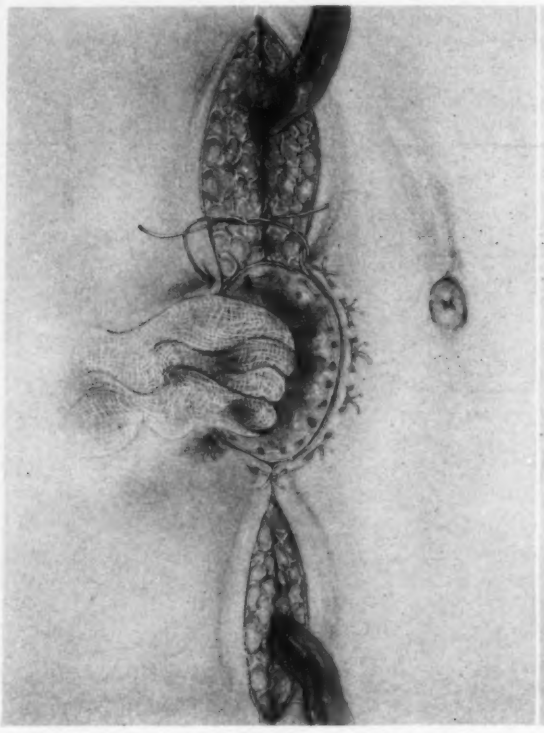


FIG. 5. Entire periphery of cyst edge sewn to the skin with silkworm sutures. The gauze pack can be seen emerging from the cyst cavity. Rubber drains are seen above and below.

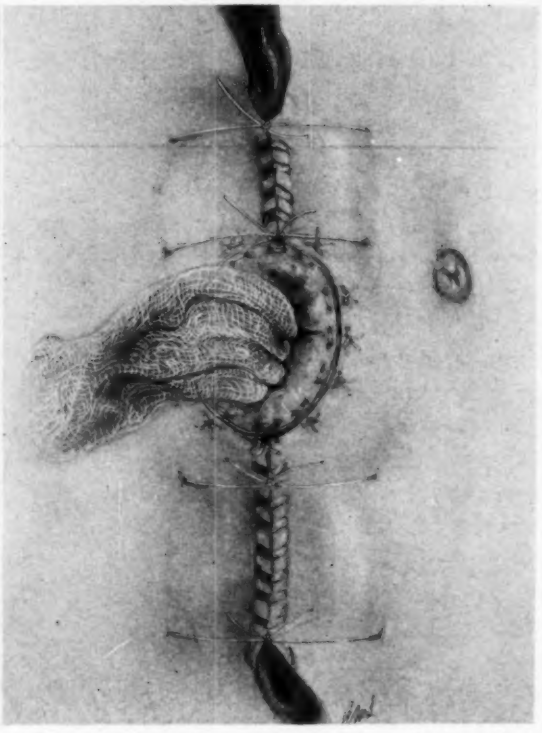


FIG. 6. Operation completed by closing the skin with metal clips. Tension sutures deeply placed have been tied. Note the relatively large opening into the cyst, permitting adequate packing with gauze.

There was little of interest in the past medical history. The patient had never had any serious illnesses. During the past four years there had been at times edema of the legs and dyspnea on exertion. These findings could well be due to the presence of an enormous pelvic tumor and to obesity. Menses were always normal until a year before admission to the hospital, at which time the periods became irregular, frequent, and the amount of blood lost greatly increased. This abnormality in menstruation was really the reason that motivated the patient to come into the hospital.

Physical Examination. The patient was short, weighed 200 pounds, and did not appear acutely ill. No abnormal findings were noted except on examination of the abdomen, where two distinct tumor masses could be seen on inspection. On palpation, there was a large, round, movable tumor occupying almost all of the left upper abdominal quadrant. This tumor could be moved freely in the transverse direction and, to a lesser extent, vertically. It gave a flat note on percussion, felt distinctly cystic, and was entirely insensitive when palpated. The pelvis was filled by a very large, hard, fixed tumor, irregular in outline and obviously a uterine fibromyoma. The examining hand could easily be placed between the two tumors, proving without doubt that there was no connection between them.

Pelvic examination made in the Department of Gynecology confirmed the diagnosis of uterine fibromyomata, and at the same time two cervical polypi were removed. Hysterectomy was advised.

Laboratory findings were as follows: Blood Wassermann and Kahn tests were negative. Urine examination revealed no abnormalities. The blood chemistry and kidney function tests were within normal limits. The blood count showed: hemoglobin 70 per cent; red cells 3,900,000; polymorphonuclear cells 76; small lymphocytes 20; and large mononuclear cells 4; the red cells showed moderate poikilocytosis and anisocytosis.

Because of the secondary anemia present, 500 c.c. of whole blood was given as a transfusion. It was then decided that the pelvic tumor be removed first to prevent further uterine bleeding, and the patient was transferred to the gynecologic department where supravaginal hysterectomy with left salpingo-oöphorectomy was done. During this operation the upper abdominal mass was palpated. It was found to be attached to the region of the mesentery, but because of many adhesions surrounding the tumor, further manipulation was not done for fear bleeding might occur. Prior to this operation the upper abdominal mass was provisionally diagnosed as a pancreatic or mesenteric cyst. The patient made an uneventful and satisfactory recovery from the hysterectomy.

She was referred to the obesity clinic for weight reduction on discharge. On April 16, 1936, she was readmitted, having lost 25 pounds, and having made an excellent recovery from her previous operation. Examination of the blood revealed a moderate secondary anemia still present.

Two days after readmission, exploratory laparotomy was done under paraldehyde-gas-ether anesthesia, using a 10-inch upper pararectus incision. (Fig. 1a.) On opening the peritoneum, the large round tumor mass immediately presented itself. (Fig. 1.) Many adhesions of the filamentous type were noted between the mass and surrounding structures. These were easily brushed off. A loop of small gut was seen to be densely incorporated in the inferior and medial aspect of the cyst wall. (Fig. 2.) The examining hand revealed that the origin of the cyst was in the mesentery close to its spinal origin at about the level of the first lumbar vertebra. Further exploration showed that the aorta and vena cava seemed to be in intimate connection with the site of attachment of the cyst. This fact, together with the complication of the attached loop of bowel and the rather advanced degree of obesity present, led to the decision to resort to marsupialization rather than to enucleate the cyst and resect the adherent small intestine.

The surrounding structures were walled off with moist pads and a trocar and cannula introduced into the dome of the cyst. (Fig. 1.) Over 1,000 c.c. of odorless milky fluid, somewhat thick in consistency, was removed and immediately sent to the biochemical laboratory for analysis, report of which will be found in this paper. Before aspiration was begun, the cyst was measured and found to be about 29 cm. in diameter. The thickness of the wall at the site of puncture was 0.5 cm. After the cyst was empty, the trocar opening was greatly enlarged to permit of inspection of the interior as well as to remove an adequate amount of wall for histologic examination. (Fig. 2.) The lining appeared to be acutely inflamed. It was somewhat roughened or velvety in appearance, and in places studded with masses of white caseous material. The empty cyst was held out of the abdomen on the stretch and sewn to the peritoneum, using interrupted chromic catgut sutures. (Fig. 3.) The peritoneum was then closed above and below its attachment to the cyst, using plain catgut. The sheath of the rectus muscle was closed snugly above and below the cyst. (Fig. 3.) Tension sutures of silkworm gut were inserted and the skin edges were sewn to the cyst opening, using mattress sutures of silkworm gut. The skin was closed with clips, and strips of rubber drain were left in the subcutaneous space at both upper and lower ends of the incision. The cyst was then tightly packed with sub-iodide gauze.

Recovery from the operation was entirely satisfactory and uneventful. Beginning on the fourth postoperative day, the removal of the gauze pack was begun, and ten days later the last portion of it came out, leaving a very small, shallow sinus. The two rubber drains were removed three days after the operation and the wound healed without infection up to the sinus. The patient left the hospital three weeks after admission with only the small sinus remaining open. She returned for inspection two weeks later and the sinus was seen to be completely obliterated. She has reported back to the hospital at irregular intervals since, and when last seen in April, 1937, one year after the operation, there had been no evidence of recurrence or of the sinus opening up. So it would seem fair to consider that a permanent cure had taken place in this case.

Pathologic Description. Gross. The specimen received consisted of an irregular "sheet-like" piece of tissue, 5 mm. thick, representing a resected portion of a cyst wall. Its external surface was smooth and shiny, having the appearance of peritoneal surface. The inner surface was shaggy and irregulàr, having a yellowish-gray color and showing numerous small crystals of a pale yellow color attached to it. These latter suggested cholesterin.

At the same time approximately 750 c.c. of a cloudy yellow fluid, the contents of the cyst, was received. In the gross this material was opaque and "creamy," strongly suggesting "chyle." Under the microscope it was seen to be made up of unidentified débris, globules of fat, cholesterin crystals, and some white blood cells. It was assigned to the chemist for analysis.

Microscopic. Sections of cyst wall showed a uniformly fibrous wall of densely packed connective tissue cells laid down in parallel form. Scattered throughout were accumulations of lymphocytes. The peritoneal surface was smooth and made up of a single layer of mesothelium. The inner surface was irregular, with no evidence of remaining endothelium. Its general structure was that of granulation tissue.

Diagnosis. Chylous cyst (mesentery) with fibrosis and chronic inflammatory changes.

*Chemical Analysis of Cyst Contents.** The sample, as received for analysis on April 21, 1936, consisted of 750 c.c. of a thick, creamy fluid, out of which settled, on standing, a white, tenacious, caseous sludge. Members of the Department of Surgery estimated that the volume preserved was approximately three-quarters of the total contents of the cyst, which, therefore, must have contained about a liter of fluid. The sediment was resuspended by vigorous shaking, and analyzed. (Table 1.) Figures for the composition of chylous cysts, chylous effusions, and chyle, taken from the literature, have been given in the table for comparison.

TABLE I

ANALYSES OF CHYLOUS FLUIDS

	Chylous Cysts			Chylous Effusions	Chyle	
	Author's Case	Zdarek (6)	Schumm (3)	Buchtala (1)	Panzer (2)	Sollman (4)
Volume	750–1,000 c.c.	70 c.c.	1,500 c.c.			
Specific gravity	1.0120	.....	9.988	1.0176		
Total solids (per cent)	12.45	10.58	39.7	8.66	9.71	7.10
Total nitrogen (per cent)	0.768	.....	.....	0.750		
N.P.N	0.160					
Protein N	0.608					
Protein (per cent)	3.84	7.19	1.95	4.69	2.16	1.85
Total Fat (per cent)	4.50	2.70	35.8	1.15	6.59	1.93
Free fatty acids	1.30					
Soaps	1.50	.....	0.43			
Neutral fat	1.70					
Ash (per cent)	1.85	0.84	0.92	0.95	0.81	0.60
Calcium (per cent)	0.468	.....	0.15	0.09		

The wide variation in composition between the types of chylous fluids listed here is striking, making comparison between them difficult. The high proportion of solids and ash, the slightly low fat content, and the high proportion of the fats present as soaps (presumably found in our sample of calcium) seem to indicate a stagnant chylous fluid undergoing dehydration.

Wells[13] mentions that chylous fluids possess marked bactericidal powers. Our experience corroborates this. Although no preservative

* The chemical analysis was made by F. C. Messer, Biochemist and Director of the John C. Oliver Research Foundation, St. Margaret Memorial Hospital, Pittsburgh, Pa.

was added to our specimen of chylous cyst fluid, and no attempt was made to keep it sterile other than storing it in a common refrigerator when it was not being used, it remained for over two months without gross evidence of putrefaction or fermentation. Cultures taken from it on May 22, 1936, one month after its arrival in the laboratory, showed a few colonies of gram-negative bacilli (saprophytes?). On June 25, 1936, a faint odor of putrefaction was first noted.

That a body fluid of relatively high protein content could remain so long unputrefied in the presence of ample opportunity for contamination, and in spite of a proved bacterial inoculation, seems difficult to account for by the inadequate refrigeration to which it had been subjected. The temperature in the refrigerator averaged 10°C., and there were several occasions when the flask containing the specimen was, by oversight, allowed to remain from eighteen to twenty-four hours in the laboratory at a temperature varying between 25 and 30°C. It seems evident that the fluid we were dealing with possessed bacteriostatic activity which, toward the end of a two-month period, gradually disappeared, either by chemical change, or being overwhelmed by successive bacterial contaminations.

A more complete report and discussion of this analysis will be published elsewhere.

REFERENCES

1. Dowd, C. N. Mesenteric cysts. *Ann. Surg.*, 32: 515–542, 1900.
2. Roller, C. S. Mesenteric cysts. *Surg., Gynec. & Obst.*, 60: 1128–1135, 1935.
3. Judd, E. S., and Heimdal, O. C. Mesenteric cysts. *S. Clin. North America*, 12: 849–855, 1929.
4. Warfield, J. O. A study of mesenteric cysts with report of two cases. *Ann. Surg.*, 96: 329, 1932.
5. Eliason, E. L., and North, J. P. Perforated chylous cyst of the mesentery. *Ann. Surg.*, 101: 1452, 1935.
6. Higgins, T. J., and Lloyd, E. Mesenteric cysts with report of two cases. *Brit. J. Surg.*, 12: 95–105, 1924.
7. Hueper, W. Mesenteric enterocystomata. *J. Lab. & Clin. Med.*, 12: 427–430, 1926.
8. Collins, A. N., and Berdez, G. L. Chyle cysts of mesentery. *Arch. Surg.*, 28: 325–334, 1934.
9. Buchtala, H. Analyse der Punktionsflussigkeit in einem Falle vom traumatischem Chylothorax. *Ztschr. f. physiol. Chem.*, 67: 42–45, 1910.
10. Panzer, T. Zur Kenntnis der menschlichen Chylusflussigkeit. *Ztschr. f. physiol. Chem.*, 30: 113–116, 1900.
11. Schumm, O. Chemische Untersuchung des Inhalts einer Chyluscyste. *Ztschr. f. physiol. Chem.*, 49: 266–272, 1906.
12. Sollman, T. Observations on human chyle. *Am. J. Physiol.*, 17: 487, 1907.
13. Wells, H. G. Chemical Pathology. Ed. 5, Philadelphia, 1935. W. B. Saunders Co., p. 405.
14. Zdarek, E. Chemische Untersuchung eines Chyluszysteninhaltes. *Ztschr. f. Heilk.*, 27: 1–2, 1906.
15. Messer, F. C. Analysis of fluid from a chylous mesenteric cyst. In press.

ORGANIC BRAIN DISEASE AND GASTRIC ULCER*

J. K. MILLER, M.D.

Resident Pathologist, City Hospital

LOUISVILLE, KENTUCKY

ALMOST one hundred years ago, Carl Rokitansky in his "Handbuch der pathologischen Anatomie" (volume III, 1841) spoke of acute softening of the stomach and believed "the proximate cause may be looked for in diseased innervation of the stomach, owing to a morbid condition of the vagus." Schiff,[1] in 1867, postulated a relationship between intracranial injuries and gastric pathology, and Hoffman,[2] in 1868, reported a case of esophageal perforation with interpeduncular tumor. By 1874, Ebstein[3] had experimentally produced changes in the gastric mucosa by trauma to the superior colliculi. Since the time of John Hunter, who spoke of gastromalacia as "a post-mortem continuance of digestion," that phenomenon has bewildered the observer at autopsy. From time to time, the possibility of a neurogenic origin of gastric ulceration and hemorrhage has been forwarded. However, until recently, the association of alimentary pathology and lesions of the central nervous system has not only been overlooked and forgotten, but even doubted.

As a matter of fact, acute and chronic gastric ulcers are known to accompany intracranial tumors, when properly situated to produce them, more often than can be explained by mere coincidence. Cushing[4] cites a number of cases from the literature and in one of his own cases observed fibrosed gastric ulcers at autopsy. This occurred in a 9 year old girl who had been operated on for brain tumor two years previously. He cites the work of a number of observers who have severed the splanchnic nerves or extirpated the celiac plexus and thus produced chronic ulcers. Numerous investigators[5] have caused chronic gastric ulcers by bilateral subdiaphragmatic vagotomies with an incidence varying from 20 to 50 per cent; experimenters failing to verify these results have generally failed to get all the vagal fibers by performing the section above the diaphragm. Ivy[6] recently has produced chronic ulcers of the stomach on the lesser curvature of the pylorus alone by bilateral vagotomy.

For some time the neurosurgeon has observed that there is often a bloody vomitus for several days after major intracranial procedures. Cushing[4] cites two cases of acute gastromalacia seen at autopsy, in which there had been regurgitation of bloody vomitus three hours ante mortem. Through Cushing, Mogilnitski,[7,8] and their fellows, attention has been called forcibly to the appearance of gastric hemorrhage and ulceration following surgery on intracranial lesions, especially of the diencephalon. In the eleven cases cited by Cushing, the surgical procedure and not the tumor was looked upon as the provocative cause of the alimentary lesion. Indeed, he found that in some cases the seat of the operative procedure was far removed from the site associated with the perforative and hemorrhagic gastric pathology.

Cushing's masterly review champions a neurogenic basis for the pathogenesis of gastric ulcer, suggesting a parasympathetic center in the diencephalon, tuberal in site, and relaying with the cranio-autonomic stations, particularly with vagal nuclei. Injury and disease along this route may be accompanied by gastric pathology.

Pharmacologically, stimulation of these postulated centers by pilocarpine and pituitrin causes, in man, gastric hyperactivity leading to retching and vomiting.[9] Cushing[9a] suggests that the neurohypophyseal principle, acting via the infundibulum, stimulates the tuberal centers or affects a

* From The Department of Pathology, Hastings State Hospital, Ingleside, Nebraska.

functional release of the vagus from the sympathetic and leads to gastric hypermotility, possible vessel spasm, and ischemic or hemorrhagic infarction, resulting in mucosal lesions.

Within the last few years, much illuminating experimental work has been done. In 1920, Ivy[10] noted petechial hemorrhages and erosions of the stomach of dogs in which there had been ablation of the cerebral hemispheres. Also, in dogs, Burdenko and Mogilnitski[8] found hemorrhagic lesions following mechanical trauma to the hypothalamus. Following their observations that faradic stimulation of the premotor areas of the monkey cortex gave rise to active intestinal movements, Watts and Fulton[11] produced various lesions of the diencephalon in sixty-three monkeys. It was found that lesions of the hypothalamus, especially in the supraoptic and tuberal nuclei, were more prone to cause profound alimentary disturbances with gastric and duodenal erosions and bleeding than lesions elsewhere in the brain. Hoff and Sheenan,[12] subjecting sixteen monkeys to hypothalamic lesions, found that the five animals showing hemorrhagic lesions of the gastric mucosa had their lesions in the tuberal nuclei. Varied forms of non-hypothalamic lesions of the brain in fifty control monkeys resulted in only one animal presenting gastric lesions and this animal had a bilateral motor and premotor extirpation five months prior to death.

The most enlightening and extensive work has come from Keller[13] and his coworkers, who used several hundred animals, both cats and dogs. They produced hemorrhagic states and erosions of the stomach by chiasmal lesions of the hypothalamus. It was observed that hemorrhagic states occurred after complete destruction of the anterior portion of the hypothalamus, whereas craters were never observed unless part of the anterior hypothalamus was intact. Invariable encroachment on the ventricular system by the injuries, resulting in contamination with blood and débris, somewhat clouded the picture, inasmuch as blood injected into the ventricular system was also found to produce gastric pathology.

Beattie[14] has produced gastric hyperemia by electrical stimulation of the tuber cinereum in animals. In view of his exacting experiments, it was suggested that hemorrhagic states were precipitated by activation in the sympathetic outflow (located in the posterior hypothalamus) and craters by activation of the parasympathetic outflow in the anterior portion. With this in mind, Keller[13b] performed bilateral vagotomies and caused the removal of the entire abdominal and a portion of the thoracic sympathetic in different animals. The results showed that vagotomy does not protect the gastric mucosa from hemorrhagic lesions and that sympathectomy does not prevent crater formation. No craters were observed in the series of animals having vagotomies; no hemorrhage was encountered in those animals with sympathectomies. Incidentally, the experiments tend to show that representatives of the sympathetic and parasympathetic (vagal) nerves are intermingled, with a predominance of the sympathetic elements in the posterior portion and a corresponding preponderance of the vagal components in the anterior portion of the hypothalamus, bearing out Beattie's observations.

Finally, Keller[13c] found that hemorrhagic states and gastric craters were encountered following hypophysectomy, these appeared identical with the changes observed following chiasmal lesions. Furthermore, vagotomy gave no protection from hemorrhagic states and sympathectomy from crater formation when these procedures preceded hypophysectomy. However, investigators believe their findings might not be due so much to the hypophysectomies as to accompanying adjacent neural derangements, possibly in the form of interventricular stimulation during the operative procedure.

Since there is an ever present balance between the sympathetic and the parasympathetic (vagal) systems, it would appear from Keller's results that destruc-

tion of the vagal center in the anterior hypothalamic area allows free play of the antagonistic sympathetic center causing hemorrhagic lesions. Conversely, destruction of the posterior hypothalamic sympathetics allows the anterior vagal elements to produce erosions. Probably at the same time that the experimental lesion is causing the destruction of one center, it is stimulating the antagonistic center by some such process as adjacent tissue edema and congestion. Hence the experimental process is dual and twofold in that it releases the antagonistic effect of one center while stimulating the remaining center.

The peripheral nerve experiments are somewhat confusing in view of the convincing work on central stimulation. An obvious explanation would be of the order of a trophic disturbance, but as Ivy has shown, the ulcers are limited to the pylorus, and apparently the "trophic" disturbance has not molested the remainder of the stomach. The vagus is apparently responsible for gastric hyperactivity and on this basis the surgeon has sectioned the vagus. The result is rest of the ulcerated stomach with satisfactory outcome in many cases. If the mechanism of vagal section is to allow free play of the sympathetics, hemorrhagic lesions would be expected in the light of Keller's work. Such is not the case. Perhaps the causation of the ulcers following vagotomy is due to preliminary stimulation of the vagus associated with the establishment of the section. Indeed, Kepplich[15] has actually produced chronic ulcers in ten of eleven rabbits by frequent continued faradic stimulation of the cervical portion of the vagi over a period of days.

In a series of seventy-two autopsies of psychotic patients, eleven presented definite gastrointestinal lesions. Of these, five were observed to have acute gastric lesions.

Case I. I. M., white, female, 74 years old, was admitted in 1915 because of schizophrenia. Cerebral arteriosclerosis developing subsequently. Hospitalization was uneventful. Following breakfast on September 13, 1936, the patient noted abdominal distention and pain in the left upper quadrant and she rapidly went into shock. There was a palpable mass in the abdomen the size of an orange. The patient died at 12:15 P.M. of the same day and the autopsy was begun at 1:20 P.M.

Autopsy Findings. Identifiable food and blood-tinged fluid was found in the abdominal cavity. The peritoneum was dull. The omentum was gathered around the stomach over a ragged tear of the anterior wall, 8 cm. in length. The entire stomach was dark, hemorrhagic, necrotic and friable. It contained, in the corpus, a bolus of undigested food the size of an orange. The mucosa showed a shaggy hemorrhagic membrane. In addition there was myocardial degeneration and hypertrophy and generalized arteriosclerosis.

Gross examination of the brain revealed moderate frontal and parietal cortical atrophy, and gray, milky, opalescent leptomeninges which were thickened and adhered to the cortex in the frontal region. The vessels of the circle of Willis and middle cerebral arteries presented yellow atheromatous plaques. Microscopy was not specific. There was a dropping out of cells and delimination of the cortical tissue, especially the third and fifth layers. The various divisions of the diencephalon, pons, and medulla showed a diffuse cell atrophy and état criblé was observed throughout. Where the disappearance of the nerve cells was most prominent, a definite neuroglial reaction had occurred. This non-specific degenerative process involved the hypothalamus.

Case II. A. P., white, male, 72 years old, was admitted November 30, 1930, due to a senile psychosis. In February 1935, he began to have vomiting after meals, and Roentgen examination revealed an irregular pylorus. In April 1936, gastric obstruction occurred and *x*-rays showed a smooth pyloric filling defect with twenty-four hour retention of barium meal. On June 4, 1936, a gastrojejunostomy was performed, but the patient succumbed to a bronchopneumonia. Autopsy was commenced six hours after death.

Autopsy Findings. Both ends of a severed peripyloric adhesion, found at operation as the cause of the obstruction, were seen on the superior and inferior sides of the pylorus. This band was 1 cm. in width. The gastric mucosa was somewhat atrophic and the pylorus showed a recent erosion 2 cm. in diameter and 5 mm. deep. There was a red hemorrhagic granulating base which was invading the serosa. Microscopy showed the typical histology of a recent ulcer, but no evidence of malignancy.

Examination of the brain showed practically the same gross and microscopic picture as in Case I.

Case III. F. D., white, male, aged 70 years, was admitted July 30, 1926, with cerebral arteriosclerosis accompanied by psychosis. Hospitalization was uneventful until March 1, 1936, when he was seized with sudden pain in the epigastrium and felt as though something had been torn. Hematemesis was rapidly followed by rigidity of the abdomen. Surgery was not advised and the patient died the eighth day. Autopsy was begun four hours after death.

Autopsy Findings. There was hemorrhagic fluid in the peritoneal cavity and the peritoneum had a gray shaggy exudate. In the region of the pylorus there was a marked edema and inflammatory reaction. On opening the stomach, six recent round ulcers, varying in size from 5 to 8 mm. in diameter, were seen in the prepyloric region. One of the larger ulcers had perforated the anterior wall. Microscopic study revealed an early erosive process in all the ulcers with typical histology.

Gross examination of the brain revealed marked frontal and parietal cortical atrophy. The ventricular system was dilated, the choroid plexus was cystic and congested, and there was a slight amount of blood-tinged fluid in the ventricles. There was a diffuse atherosclerosis of the cerebral vessels. Microscopic section showed cellular atrophy and état criblé in both cortical and midbrain tissue.

Case IV. J. O. C., white, male, 74 years of age, was admitted September 20, 1935 with cerebral arteriosclerosis and pyschosis. On November 5, he vomited his evening meal and in the morning complained of epigastric pain. By noon there was board-like rigidity of the abdomen. The patient was operated on for possible perforated peptic ulcer. At operation a fresh eroded area, 3 cm. by 5 mm., was found on the posterior wall of the first part of the duodenum and closure was attempted. The patient died on November 19 of acute anuria. Autopsy was begun two hours post mortem.

Autopsy Findings. The peritoneal cavity had 600 c.c. of bloody fluid and the peritoneum was covered with a gray, shaggy material. The gastric mucosa was atrophic. The duodenal lesion was hemorrhagic and necrotic. The remainder of the duodenum showed an acute hemorrhagic inflammatory process.

Examination of the brain showed an advanced atherosclerosis of the circle of Willis and the middle cerebral arteries; otherwise gross examination was negative. Histologically there was diffuse cellular atrophy of the cortex and nuclei of the mid-brain with an état criblé. There was an advanced arteriosclerotic nephritis and generalized arteriosclerosis. Histology of the ulcer showed it to be of recent origin with no fibrosis.

Case V. E. A., white, male, aged 58 years, was admitted February 11, 1931, as a manic depressive. Hospitalization was uneventful until May 1, 1936 when the patient had hematemesis, melena, and signs of gastric obstruction. A diagnosis of gastric carcinoma was made, but before *x*-ray studies or surgical consultations were arranged, the patient died (May 9, 1936). Autopsy was begun in one and a half hours.

Autopsy Findings. The gastric mucosa was atrophic. In the prepyloric region eight well demarcated, recent ulcers, 5–10 mm. in diameter, were seen. The duodenum was hemorrhagic and in the first portion was an 8 mm. ulcer with a bleeding, granulating base. The head of the pancreas was twice normal size and encroached on the first and second parts of the duodenum, causing 60 to 75 per cent obstruction. There was associated myocardial hypertrophy, generalized arteriosclerosis and renal arteriosclerosis. Examination of the central nervous system was not permitted. Histologically the ulcer showed no fibrosis and there was a diffuse chronic pancreatitis.

Note. Recently two additional cases of acute perforated peptic ulcer in men of 60 to 70 have been observed. One case, in which a brain examination was done, showed cortical atrophy and generalized cerebral arteriosclerosis.

DISCUSSION

Mayo[16] has stated that the incidence of gastric ulcer is under 1 per cent of the findings in general autopsies. However, Stewart,[17] in a series of 6,800 consecutive autopsies, found gastric ulcer in 2.2 per cent and duodenal ulcer in 2.9 per cent. Of 1,500 autopsies in which close study was made, the evidence of gastroduodenal ulcer was 8.7 per cent, 4.5 per cent incidence in each type alone. Ninety per cent of the gastric ulcers and 84 per cent of the duodenal ulcers occurred in the age range of 30 to 69 years. In females there were only 7.5 per cent of the ulcer cases over

60 years and in males 23.5 per cent were 60 years or over.

TABLE I

	No. of Cases
Total deaths	102
Total autopsies	72
Incidence of cerebral arteriosclerosis	22*
Incidence of acute hemorrhagic and erosive gastric pathology-gross	5†
Net incidence of the gastric pathology in cerebral arteriosclerosis	4
Gross incidence of gastric pathology	7 per cent
Net incidence of gastric pathology	18 per cent

* The twenty-two cases include all eleven clinical cases of cerebral arteriosclerosis, nine of the eleven senile psychoses, one schizophrenia, with associated cerebral arteriosclerosis, and one manic-depressive with cerebral arteriosclerosis.

† One case of manic-depressive psychosis showed acute gastric pathology, but central nervous system examination was not permitted.

TABLE II

Decade	Total Cases	Cases of Acute Gastric Pathology	Percentage
20–29	2	0	0
30–39	2	0	0
40–49	3	0	0
50–59	14	1	7
60–69	0	0	0
70–79	20	4	20
80–89	12	0	0

In this series, the gross incidence of hemorrhagic and erosive gastric lesions is 7 per cent, an incidence well within the range generally found. However, the incidence of acute gastric pathology with cerebral arteriosclerosis rose to 18 per cent, and 80 per cent of the cases occurred in the age period of 70 to 79 years. The incidence of gastric pathology in this decade was 20 per cent. This incidence of acute gastric pathology associated with cerebral arteriosclerosis and found in an age period (70–79 years) where gastric ulceration is not prevalent, is too large to be coincidental.

Pathologically, Case I showed a diffuse acute hemorrhagic necrosis, present one hour after death, with rupture and peritonitis. Microscopically, there was extensive tissue necrosis and hemorrhage. Case II presented early gastric ulcer whose associated inflammatory process had produced obstructive symptoms. Cases III and IV revealed multiple ulcers of recent origin, in which perforation had ensued, causing death. Case V presented a non-perforating but bleeding ulcer (duodenal).

None of these cases offered a diagnostic past history and the syndrome was recent and acute. The ulcers did not show the scarring and contraction of the gastric wall indicative of chronic processes. Microscopically, they failed to reveal the usual dense, mature, inflammatory fibrous tissue in the walls and floor of the ulcer, observed in old ulcers.

Each of four cases (I to IV) with central nervous system examination showed a diffuse cerebral arteriosclerosis and, although no specific and localized lesion limited to the diencephalon and particularly to the hypothalamus could be demonstrated, a generalized degenerative process commonly attributed to cerebral arteriosclerosis included these areas. In addition, one case (IV) showed a bloody intraventricular fluid. No acute ulcerative gastroduodenal pathology was found in any of the other groups of non-organic psychoses.

From the clinical observations of the neurosurgeon and such cases as are presented here, and from the experimental work of such investigators as Keller, it would appear that, at least in some cases, injury and disease inducing pathologic changes in the physiology and anatomy of the hypothalamic portion of the diencephalon, produces hemorrhagic and erosive lesions of the upper alimentary mucosa. The tuberal cluster of cells associated with a preponderance of vagal (parasympathetic) elements in the anterior hypothalamus seems to be the area exciting erosions. The post-hypothalamic center with sympathetic fibers predominating is believed to be the site for excitation of hemorrhagic states.

Although no specific intrabrain lesion is demonstrated, these five cases of acute hemorrhagic and erosive lesions of the stomach and duodenum in aged patients, four over 70 years, associated solely and

entirely with cerebral arteriosclerosis (organic brain disease) suggest intrabrain pathology as an etiologic basis for the alimentary process.

With such data at hand, it seems reasonable to infer that a neurogenic theory for the pathogenesis of acute gastric and duodenal ulcer is being revived on a sounder basis than heretofore. It offers a logical explanation for some cases of gastric pathology.

I do not offer these cases as proof of establishing a thesis, but rather as a plea for future intensive search for the association of organic brain disease and gastroduodenal pathology, ever of a negative nature. Special consideration of the diencephalon is advocated in this search.

SUMMARY

Five cases of acute gastroduodenal ulcers in patients over 58 years of age, in which there was associated intracranial pathology due to cerebral arteriosclerosis, are reported. Evidence is adduced to emphasize the fact that the incidence of gastric ulcer and organic brain disease in the series is higher than can be accounted for merely or solely on the basis of coincidence. From clinical observation and experimental evidence in the literature, the suggested center in the brain responsible for such alimentary pathology appears to be localized in the diencephalon, particularly in the hypothalamus.

REFERENCES

1. Schiff, M. Leçons sur la physiologie de la digestion. Florence, 1867. H. Loescher.
2. Hoffman. Ueber die Gefaessnerven des Magens und die Function Littlern Straenge des Rueckenmarkes. *Arcb. f. physiol. Hulk.*, 22: 30–38, 1854.
3. Ebstein, W. Experimental Untersuchenungen ueber das Zustandekommer von Blutextravasation in der Magenschleimhaut. *Arcb. f. exper. Patb. u. Pbarmakol.*, 2: 183–195, 1874.
4. Cushing, H. Peptic ulcer and the interbrain. *Surg., Gynec. & Obst.*, 55: 1–3, 1932.
5a. van Yzeren, W. De pathogenese van de chronische maagsweer. *Ztscber. f. klin. Med.*, 43: 181, 1901.
5b. Ophuls, W. *J. Exper. Med.*, 8: 181, 1906.
5c. Zironi, G. *Arcb. f. klin. Cbir.*, 91: 662, 1910.
5d. Greggio, E. *Arcb. de méd. expér. et d'anat. patb.*, 27: 533, 1916.
5e. Alvarez, W. W., Hosio, K., Overgard, A., and Ascanio, H. *Am. J. Physiol.*, 90: 631, 1929.
5f. Donati, M. *Arcb. f. klin. Cbir.*, 73: 908, 1904; also *Zentralbl. f. Cbir.*, 31: 346, 1904.
6. Beazell, J. M., and Ivy, A. C. Chronic gastric ulcer following bilateral vagotomy in the rabbit and in the dog. *Arcb. Patb.*, 22: 213–220, 1936.
7. Mogilnitski, B. N. Zur Frage der Entstehungsweise und Ursache neurogener Formen des runden Magengeschevuers. *Arcb. f. patb. Anat.*, 257: 109–118, 1925.
8. Burdenko, N., and Mogilnitski, B. N. Zur Pathogenese einigen Formen des runden Magen-Darmgeschwuers. *Ztscbr. f. Neurol. u. Psycbiat.*, 103: 42–62, 1926.
9a. Cushing, H. Reaction of posterior pituitary extract when introduced into the cerebral ventricles. *Proc. Nat. Acad. Sc.*, 17: 163–180; 239–264, 1931.
9b. Light, R. U., Bishop, C. C., and Kendall, L. G. Production of gastric lesions in rabbits by injections of small amounts of pilocarpine in the cerebrospinal fluid. *J. Pbarmacol.*, 1932 (from Cushing).
9c. Fulton, J. F., and Ingraham, F. D. Emotional disturbances following experimental lesions of the base of the brain. *J. Physiol.*, vol. 67, 1929; also *Proc. Physiol. Soc.*, pp. 27–28 (April 27) 1929.
9d. Ferguson, J. H., and Smith, E. R. B. *Am. J. Physiol.*, 109: 34, 1934.
10. Ivy, A. C. Contributions to the physiology of the stomach. *Arcb. Int. Med.*, 25: 6, 1920.
11. Watts, J. W., and Fulton, J. F. The effect of lesions of the hypothalamus upon the gastrointestinal tract in monkeys. *Ann. Surg.*, 101: 363 (Jan.) 1935.
12. Hoff, E. C., and Sheehan, D. Experimental gastric erosions following hypothalamic lesions in monkeys. *Am. J. Patb.*, 11: 789, 1935.
13. Keller, A. D., et al. *a.* Ulceration in the digestive tract of the dog following intracranial procedures. *Arcb. Patb.*, 21: 127–165, 1936. *b.* Protection by peripheral nerve section of the intestinal tract from ulceration following hypothalamic lesions with preliminary observations on ulceration in the gastrointestinal tract of the dog following vagotomy. *Arcb. Patb.*, 21: 165–185, 1936. *c.* Ulceration of the digestive tract of the dog following hypophysectomy. *Arcb. Patb.*, 21: 185–202. *d. Arcb. Neurol. & Psycbiat.*, 32: 1253, 1934. *e. Proc. Soc. Exper. Biol. & Med.*, 30: 772, 1933; also 29: 1069, 1932. *f. Am. J. Physiol.*, 113: 78, 1935. *g. Am. J. Physiol.*, 105: 61, 1933. *b. Proc. Soc. Exper. Biol. & Med.*, 30: 1175, 1933.
14. Beattie, J. *a.* The relation of the tuber cinereum to gastric and cardiac function. *Canad. M. A. J.*, 26: 278, 1932. *b.* Hypothalamic mechanisms. *Canad. M. A. J.*, 26: 400–405, 1932. *Proc. Roy. Soc.*, 106: 253, 1930 (with G. R. Brow and C. N. H. Long).
15. Keppich. *Berlin klin. Wcbnscbr.*, 48: 414–416, 1921.
16. Mayo, C. *Brit. M. J.*, 2: 103, 1920. (Discussion of paper.)
17. Stewart, M. S. The pathology of gastric ulcer. *Brit. M. J.*, 2: 1021–1025, 1923.

DRESSING FOR REDUCTION AND FIXATION OF FRACTURES OF RADIUS AND ULNA*

VICTOR CARABBA, M.D., F.A.C.S.

Assistant Clinical Professor of Surgery, New York University

NEW YORK CITY

FRACTURES of the forearm still present a problem from the standpoint of treatment. The proper form of treatment is a subject of discussion even amongst the most able representative group of specialists. Bearing this in mind, one can readily recognize the difficulties encountered by the general practitioner and general surgeon.

Stimson[1] affords an excellent review of the literature up to 1934. "Fractures of the forearm, wrist and hand," he believes, "present no particular difficulty in diagnosis; the anatomy is well known, but the treatment of such fractures is the subject of considerable discussion, particularly in view of the recent development of the wire methods. Closed reduction with the application of plaster while traction is being maintained manually, is advocated (Oberzimmer, Miller). This is not always successful, however, and various methods of introducing wire through the bones above and below the fracture, and incorporating the ends in plaster, are suggested (Oberzimmer, Clayton, Roger Anderson). Open reduction with internal fixation still has its advocates (Rufer, Sowles, Babbini, Nicolini). All present careful statistics, and the choice of method, as for fratures elsewhere, must depend on the type of the fracture, the patient and the doctor."

The purpose of this article is to describe a simple method of reduction and fixation of fractures of bones of the forearm, which is surgically correct for anatomic reduction and fixation, and extremely practical even in the hands of the least experienced.

APPLICATION OF DRESSING

This form of dressing is used whenever closed reduction with application of plaster fails either to reduce or maintain the reduction. The dressing is used whether the radius or ulna alone or both bones together are fractured.

The site of the fracture is determined either clinically, or by measurement from the *x*-ray plates. The site of the fracture is marked off in the dorsal aspect of the forearm. (Fig. 1A.) In fractures of a single bone or both bones at the same level, one mark is sufficient. When there are fractures of both bones at different levels, each level must be marked separately. After the forearm has been shaved, two strips of moleskin plaster are fashioned, 12 to 18 inches in length and 3 to 4 inches in width. Each strip is then applied on the dorsal aspect of the forearm from the fracture towards the back of the hand and tip of the olecranon. (Fig. 1A.)

If there are fractures of both bones at separate levels, the distal strip of moleskin is applied to the mark of the fractures at the lowest level towards the hand, and from the mark of the fracture at the highest level towards the elbow. These strips of mole skin are further affixed to the forearm by cross strips of adhesive 1 inch wide, which do not meet in the midline on the anterior surface of the forearm.

To insure further against slipping or stretching of the moleskin, the back of the moleskin strips affixed to the forearm is painted over with several layers of water

* From the New York University College of Medicine and the Third Surgical Division, Bellevue Hospital, Arthur M. Wright, M.D., Director.

Fig. 1. A, site of fracture marked. Moleskin strips affixed to extensor surface of forearm from fracture site and towards the hand and elbow. B, double bass wood splint placed between the loose ends of the moleskin strips which are fixed to the back of the splint. C, cotton padding between splint and forearm at elbow and back of hand, separating splint from forearm for 3 to 4 inches.

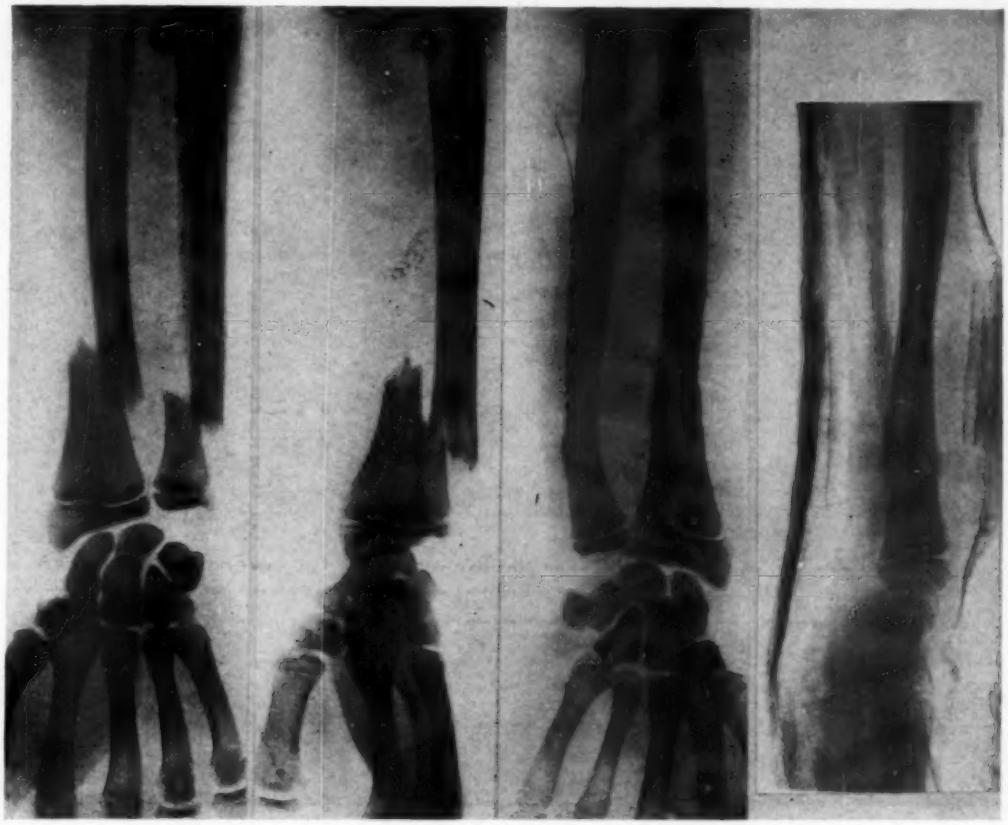
glass (sodium silicate). A circular gauze bandage applied at this time, and also covered by a layer of sodium silicate in the region of the moleskin strips and allowed to dry further prevents slipping. The bandage of course must not cover the fracture site between the traction strips of moleskin.

Two bass wood splints are fashioned, so that their length is equal to the distance between the knuckles and the tip of the olecranon. They are held together by

FIG. 1. D, splint bent with convexity towards forearm and fixed in this position by circular bandages in the center and ends. E, circular reinforcing bandage, F, moulded plaster splint extending to arm with forearm in flexion.

several strips of adhesive. At this point in the procedure, it is advisable to administer an anesthetic and apply traction to obtain as much reduction of overriding as possible.

A circular bandage is applied loosely around the splint and forearm at the level of the packing at the elbow joint and the palm of the hand. (Fig. 1D.)



A B

Fig. 2. Case 1. A, fracture of radius and ulna before reduction. B, reduction and result obtained on discharge of patient.

In most of our early cases we used preoperative medication of morphine alone, and did not attempt to obtain a preliminary reduction by traction. While the results were excellent, we feel that the administration of an anesthetic, either local or general, with traction, gives better results. The double bass wood splint is placed between the loose ends of the moleskin strips and is affixed to them as close to the forearm as possible, by means of cross strips of adhesive. (Fig. 1B.)

Non-absorbent cotton padding is next affixed at both ends of the bass wood splints, as shown in Figure 1C, so that the bass wood splint is separated from the forearm for a distance of 3 to 4 inches.

Grasping the ends of the splint, the operator bends it toward the forearm, with its convexity toward the forearm and its concavity toward the operator. This causes a tremendous pull and readily reduces the fracture. The position of the splint is maintained by a circular bandage in the center of the splint, as shown in Figure 1D. This procedure not only reduces the fracture, but maintains the reduction by constant traction until the healing process occurs. Since the fracture deformity is usually towards the palmar aspect of the forearm, the circular center bandage holding the traction arch of the splint further insures proper longitudinal alignment of the fragments.

When *x*-rays reveal proper reduction, a circular gauze bandage is applied around the forearm and splint. (Fig. 1E.) A moulded plaster splint is fashioned, long enough to be applied in sugar tong fashion about the elbow joint and side of splint, to insure immobilization of the elbow joint flexed at right angles. (Fig. 1F.) A sling is used to help the patient carry the affected part.

A B

FIG. 3. Case II. A, fracture of radius before reduction. B, reduction and final result obtained.

In fractures of the upper third of the radius and ulna, the reduction is performed with the forearm in complete extension. The upper moleskin strip is extended to the lower third of the arm above the olecranon. The splint must, therefore, extend from the level of the lower third of the arm to the knuckles. When reduction is obtained, a posterior moulded splint is applied from the hand to the upper arm to prevent slipping of the dressing.

The dressing must be inspected and *x*-rayed at least once a week to insure maintenance of reduction. In none of our cases have we had any impairment of circulation, and there seems to be slight possibility of this complication.

Immobilization is maintained from three to six weeks, depending on the age of the patient and the rapidity of callus formation. The best results are obtained by keeping patients in bed without movement for two or three weeks, or until the fragments begin to unite. This permits of repeated *x*-ray check-up studies and readjustments, if necessary.

CASE REPORTS

CASE I. C. W., age 14 (#4972), was admitted to Bellevue Hospital on August 31, 1936 with a history of a fall in which the back of his wrist struck the ground and his whole body fell on the arm. He immediately suffered severe pain and noticed marked angulation of his left forearm. *X*-ray films showed a transverse fracture of both the radius and the ulna, with forward displacement of both distal fragments and dorsal displacement of the

proximal fragment. (Fig. 2A.) Reduction was obtained and the final result with the application of the traction method above described obtained. By October 28, 1936, the patient had excellent pronation and supination, with almost complete restoration of muscular power.

A B

Fig. 4. Case III. A, fracture of radius before reduction. B, reduction and final result obtained.

is shown in Figure 2B. The dressing was removed in eighteen days. The patient returned to the clinic on October 17 and again on October 28, 1936, and showed excellent unison and perfect anatomic and functional results.

Case II. J. C., age 56 (#4966), was admitted to Bellevue Hospital on August 3, 1936. The patient had been pushed off a chair, striking and fracturing his right forearm against an iron railing. *X*-ray revealed a comminuted fracture of the lower third of the right radius, with the distal fragment displaced medially and forward. (Fig. 3A.) Several attempts at closed reduction plus application of moulded plaster splints failed. The traction dressing was applied on August 6, 1936. The post-reduction *x*-ray showed in the anteroposterior view an excellent alignment, while the lateral view revealed a position luxation of the proximal fragments. (Fig. 3B.) Since the fragments were touching, and on careful return clinics the position was maintained, progress was considered satisfactory. Immobilization was maintained for six weeks before solid union was

Case III. S. P., age 13 (#4909), was admitted to Bellevue Hospital on September 4, 1936, with a history of having fallen backward on his outstretched hand. Examination revealed a deformity about 2 inches above the wrist, with the angulation directed anteriorly. *X*-ray revealed a fracture of the lower part of the right radius with marked anterior angulation and fracture of styloid process of the ulna. (Fig. 4A.) Under anesthesia, the fracture was reduced on the same day and moulded splints were applied. The patient returned for examination on September 16, 1936, and it was found that the angulation had recurred. The fracture was again broken up and the traction dressing reapplied. Immobilization was maintained until October 7, 1936, with excellent union and good clinical result. On October 14, 1936, reëxamination showed excellent alignment of fracture, good union and excellent fractional result. (Fig. 4B.)

REFERENCE

1. Stimson, Barbara B. A review of the 1933–1934 literature in fractures. *Surg., Gynec. & Obst.*, 62: 8 (Jan.) 1936.

NEUROBLASTOMA OF THE SMALL INTESTINE*

SAUL ALFRED RITTER, PH.D., M.D., F.A.C.S.

Assistant Attending Surgeon, Misericordia Hospital

NEW YORK CITY

PRIMARY neuroblastoma of the small intestine is a rare lesion, as witnessed by the fact that to date there have been only four cases reported in the literature. This tumor is an embryonic malignant neoplasm which originates from the early formed neuroblasts. Embryologists agree that the primitive undifferentiated nerve cells are of ectodermal origin, and early in the course of the histogenesis of the nervous system these cells differentiate into spongioblasts and neuroblasts. The former develop the supporting neuroglia structures of the central nervous system, while the latter are the precursors of neurons and also of the migrating cells which spring from the ganglionic crest, the anlage of the sympathetic nervous system. Some of these neuroblasts migrate ventrally toward the aorta to form the sympathetic chains with their paraganglionic structures and also invade the mesodermal part of the suprarenal glands to form their medullae. It is believed by some,[1] that such primitive nerve cells may come to rest anywhere in the body, remain in a latent state and at some later time may proliferate and become neoplastic.

Neuroblastoma arises most frequently in the medulla of the suprarenal glands in young children and may metastasize to adjacent glands, viscera, skull and bones. Cases of this type have been reported by Marchand,[2] Kuster,[3] Wiesel,[4] Wright,[5] Landau,[6] Pick and Bielschowsky,[7] Pick,[8] Wahl,[9] Harbitz,[10] Lehman,[11] Lambert,[12] Wolbach and Morse,[13] Martius,[14] Dunn,[15] Gunby,[16] Anderson and Shennan,[17] and Askin and Geschickter.[18]

Primary neuroblastoma in other sites than the suprarenal glands has been reported in the sympathetic ganglia, retroperitoneal tissues, coccygeal gland, nose, uterus, thoracic cavity, skin, scapular region, carotid gland and thigh.

Observations to date have indicated that the term neuroblastoma must be reserved for tumors composed only of the undifferentiated type of nerve cell. Tumors composed of ganglion cells with well differentiated nerve fibers are called ganglioneuroma; these, unlike the neuroblastomas, are highly differentiated and usually benign. The third form of neurogenic tumor is the paraganglioma, which is largely composed of chromaffin cells, and is also benign.

Where ganglion cells have been found in typical neuroblastomata, they are to be regarded as forms in which partial transition has taken place from the primitive neuroblast to the mature ganglion cell.[6,8,9,14,15] Mixed neurogenic tumors containing all three elements, ganglioneuroma, neuroblastoma and chromaffine cells, have been reported by Wahl and others.

In 1925, I[19] reported two cases of primary neuroblastoma which arose in the wall of the jejunum presumably from the nerve cells of the intestinal sympathetic plexus (Meissner's and Auerbach's). A recent review of the literature has revealed the reports of only two additional cases of primary neuroblastoma arising in the wall of the small intestine.[20,21] It is interesting to note that in all four of the reported cases the neoplasm occurred in persons past middle age. Ferrero's case was 61 years old, Cames and Cid's case was 55 years old, and the two cases reported by me were respectively 55 and 64 years old. In contradistinction, attention is called to the fact that primary neuroblastoma occurring in the

* Read before the Surgical Section of the New York Academy of Medicine, Jan. 8, 1937.

suprarenal glands most often occurs in young children, and manifests itself by diffuse metastases. Only two exceptional cases occurring in middle aged persons have been reported by Meltzer.[22]

CASE REPORTS

Case I. Abstract of a case of primary neuroblastoma arising in the wall of the small intestine, spreading to adjacent loops of intestine and metastasizing to the mesenteric lymph nodes and liver, reported by V. Ferrero[20] of Torina, Italy, in 1922.

B. T., 61 years old, female, complained of loss of appetite, spells of vomiting and only very slight abdominal pains. There were periods of constipation alternating with diarrhea. There had been a marked loss of weight, and the patient had noticed a gradual enlargement of the abdomen for about three months. The abdomen was distended and a mass the size of an adult's head was palpable between the umbilicus and the pubis. It was smooth, firm, bilobular, movable, but not particularly painful. Upon bimanual examination the mass could be felt through the right fornix. A diagnosis of malignancy of the right ovary was made.

Laparotomy revealed a globular neoplastic mass growing in the wall of the small intestine and involving several other loops of the intestine. The tumor was adherent to the omentum, parietal peritoneum, ascending colon and to the right lobe of the liver. It looked like an inoperable carcinoma with metastases in the liver. A biopsy was performed and the abdomen was closed. The patient died from a perforating peritonitis twenty-seven days after operation.

A partial post-mortem examination was made. Many adhesions were present between loops of the small intestine, and there was a growing neoplastic mass, involving several loops of small intestine, which was adherent to the omentum, parietal peritoneum, ascending colon and the right lobe of the liver. The neoplasm was a rose-colored encephaloid mass, growing in the wall of the small intestine and involving several loops of gut. The tumor was disintegrated in places, and one loop of intestine was necrotic and perforated into the peritoneal cavity. The liver contained metastatic nodules, and the gall-bladder contained many calculi, but there was no neoplastic involvement of the retroperitoneal structures.

Microscopically the tumor was found to be growing between the muscularis and the serosa of the small intestine. The tumor appeared to be of nervous origin, corresponding to neuroblastoma. Ferrero states his belief that the growth was a malignant neuroblastoma of the intestine formed by the sympathetic elements in the intestinal wall. He describes the microscopic structure of the tumor in detail, but publishes no photographic or photomicrographic studies.

Case II. Abstract of a case of neuroblastoma arising in the wall of the jejunum without metastases, reported by Cames and Cid[21] of Argentine, in 1933.

A. P., 55 years old, male, complained of nausea, colicky pains in the abdomen, accompanied by diarrhea and occasionally bloody stools. Shortly after admission to the hospital there was copious bleeding in the stools, nausea and syncope.

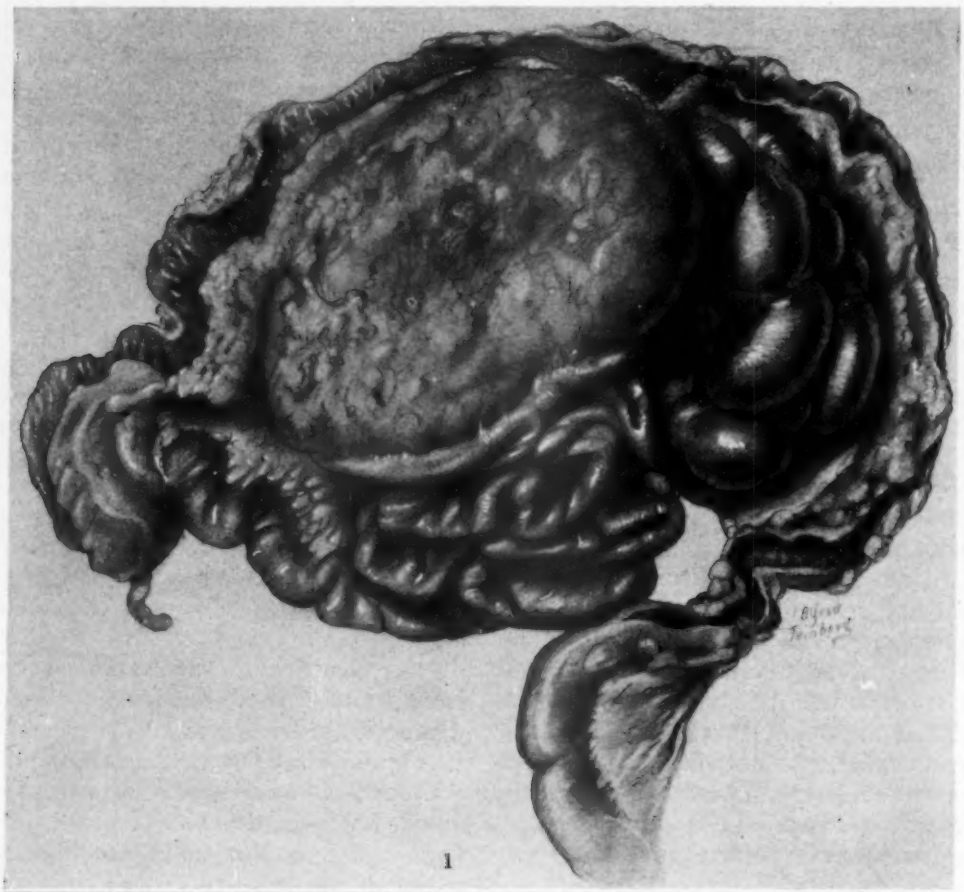
Roentgen ray examination revealed an irregularity of the bulb of the duodenum and a diagnosis of bleeding duodenal ulcer was made.

A laparotomy was performed, the duodenum was opened, but no sign of ulcer was found. The colon, however, was full of blood, and 50 cm. from the first portion of the duodenojejunal region a sessile tumor was found at the free border of the jejunum. It measured 4.5 cm. in height and 2 cm. in thickness. It was homogenous, hard, superficially vascularized, smooth and grossly resembled glandular tissue. There was no dilatation of the proximal loop of the intestine. No metastases were present in the lymph nodes or viscera. At one point in the mucous membrane at the site of the neoplasm, there was an ulceration which accounted for the hemorrhage. The tumor arose between the serosa and the muscularis of the intestine.

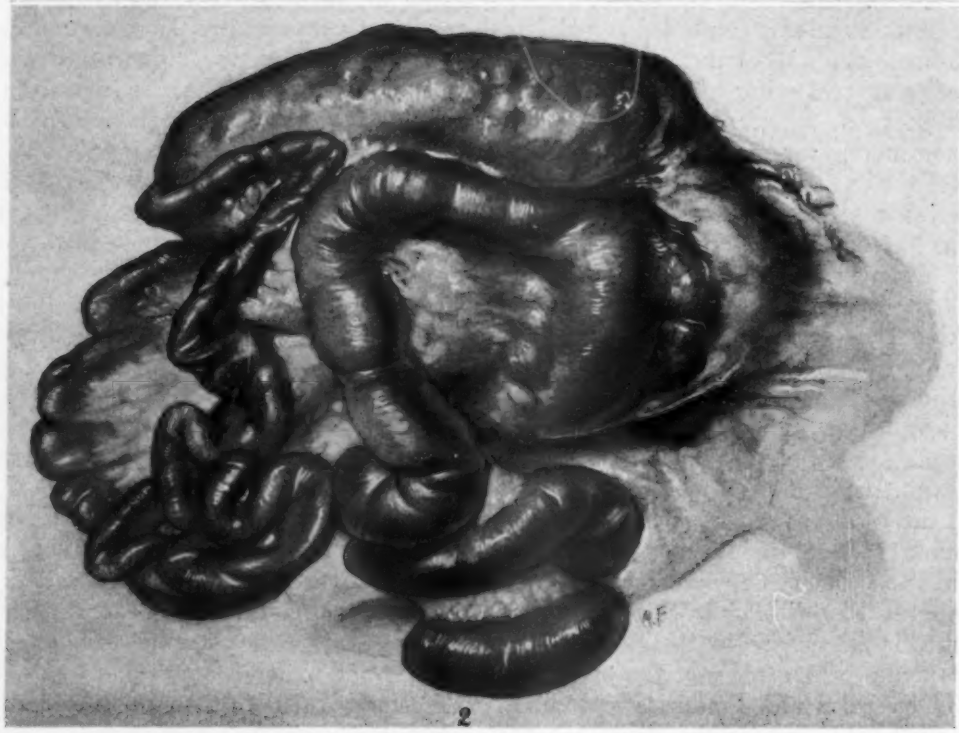
Five cm. of the intestine proximal and 5 cm. distal to the tumor were excised and an end to end anastomosis was made. The patient recovered without any postoperative complications and was discharged from the hospital.

Microscopic examination of the tumor revealed it to be a neuroblastoma, made up largely of neuroblasts, bipolar cells grouped in alveolar arrangement with characteristic fibrils. There were no sympathogonia or ganglionic cells. The microscopic characteristics were described in detail, with photographs and photomicrographs.

Case III. Primary neuroblastoma arising in the wall of the jejunum with extension to the



1



2

FIG. 1. Anterior view of neoplasm in wall of jejunum involving adjacent loops of intestine, producing partial obstruction.

FIG. 2. Posterior aspect of the same neoplasm in the jejunum.

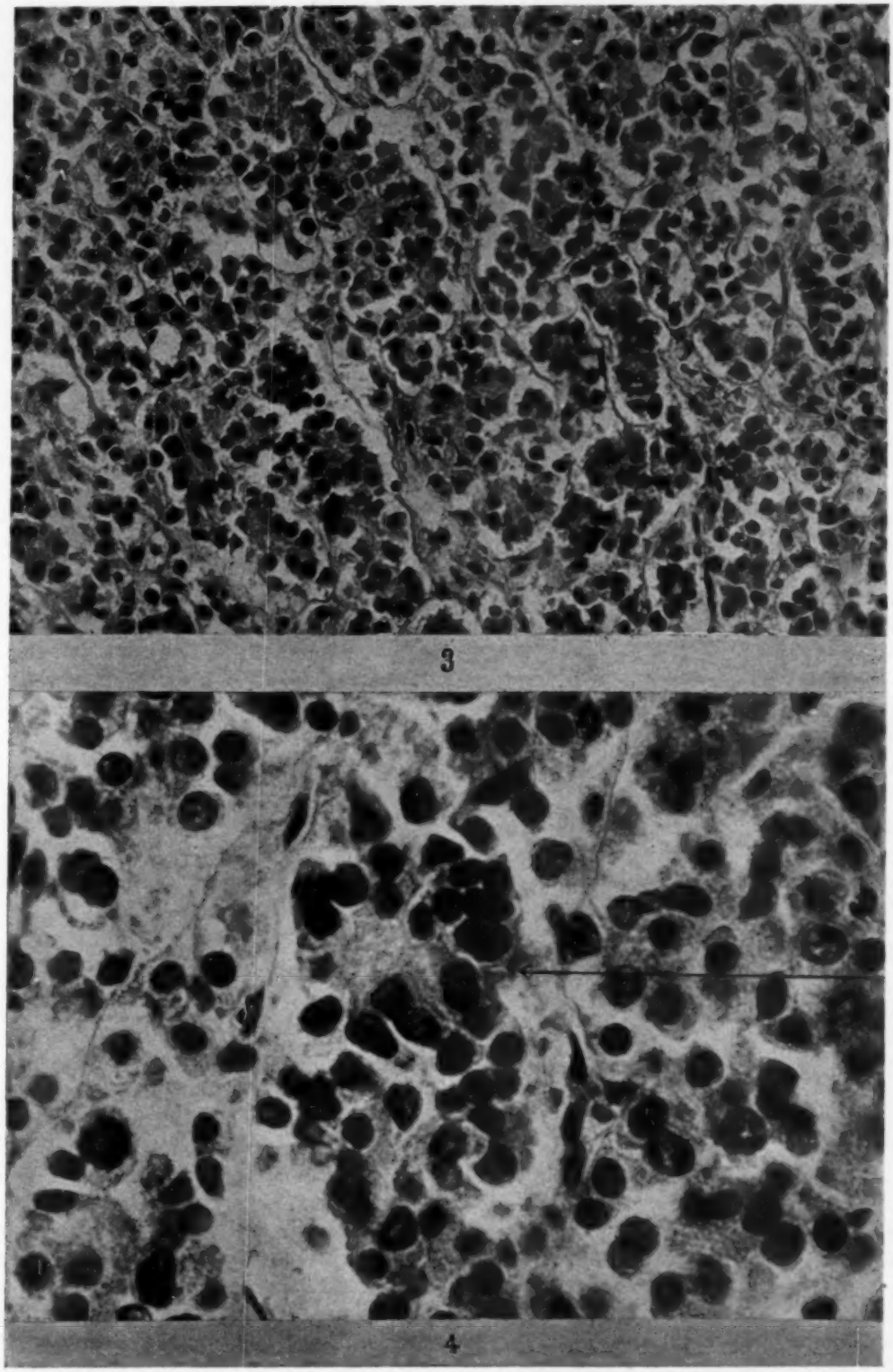


Fig. 3. Microscopic view of tumor under low power. Shows numerous round "lymphoid" cells with deeply stained nuclei rich in chromatin granules, surrounded by little cytoplasm. There is a fine fibrillar stroma scattered throughout the field. Cells present an alveolar arrangement and here and there show "rosette" formations.

Fig. 4. High Power. Showing a typical rosette formation.

adjacent loops of intestine and metastases in the mesenteric lymph nodes, reported by me in 1925.[19]

H. A., A widow of 55, was admitted to the Mount Sinai Hospital in March 1924 with the complaint of increasing constipation for four months. The constipation was obstinate and required drastic cathartics for relief. There were no abdominal pains or cramps, and no nausea, vomiting, jaundice or melena. The stools were usually well formed and brown in color. She had lost about 30 pounds in the preceding four months.

The patient was emaciated. The abdomen was distended. On palpation a large oval, smooth, hard, immovable mass could be felt in the epigastrium, extending down to the level of the umbilicus, more to the right than to the left of the midline. There was marked generalized voluntary rigidity of the abdominal muscles. *X*-ray examination of the colon with the aid of a barium enema showed that the sigmoid was markedly compressed by an intra-abdominal mass.

Exploratory laparotomy disclosed a large neoplastic mass, densely adherent to the anterior abdominal wall, which was apparent after separation of the adhesions as well as the adherent omentum from the upper aspect of the tumor. The mass was about 8 cm. in diameter, gray in color and rough in surface. It appeared to occupy the upper part of the mesentry and in it were incorporated loops of the upper portion of the jejunum. The large intestine encircled the mass, but was not invaded by it.

Five days after exploratory laparotomy the patient died from an extensive post-operative pneumonia.

Necropsy. When the peritoneal cavity was opened, a large oval, firm, grayish-white mass, measuring 15 by 10 cm. was found. It involved several loops of jejunum 5 cm. distal to the fossa duodenojejunalis and the contiguous mesentery. There were many fibrous adhesions between the parietal peritoneum of the anterior abdominal wall, the omentum and the anterior surface of the neoplasm. The tumor apparently arose in the wall of the jejunum and by direct extension involved the walls of several adjacent loops of the jejunum and extended backward, distorting and invading the mesentery and the mesenteric lymph nodes in this region for a distance of about 5 cm. from its main attachment. As the result of erosion of the walls of the adjacent loops of intestine by invading neoplasm, an intercommunication was established among several loops of the jejunum forming a cavity, the wall of which was made up partly of intestine and partly of tumor. The anterior surface of the mass, after separation of fibrinopurulent omental adhesions, was found to be greenish-yellow in color and necrotic in places. The free surface of the cystic cavity of the neoplasm was thrown up into large, firm, salmon-pink colored, irregular excrescences, covered by a film of thick mucus. Here and there necrotic areas were found. Cut sections of solid portions of the tumor presented a homogeneous pinkish-white friable surface. The duodenum and jejunum proximal to the site of the neoplasm were widely dilated, due to partial constriction of the lumen of the jejunum at the site of the neoplasm. The distal portion of the jejunum and the ileum were collapsed. The large intestine encircled the neoplasm without being involved in the growth. On the basis of gross observation a tentative diagnosis of sarcoma of the intestine was made. (Figs. 1 and 2.)

The lungs were the seat of an extensive post-operative bronchopneumonia. The suprarenal glands were normal. Examination of all other organs revealed no significant findings.

Microscopic Anatomy. Microscopic study of the tumor showed it to be composed essentially of numerous round, small "lymphoid" cells, containing deeply stained nuclei, rich in chromatin granules and surrounded by very little cytoplasm. Scattered throughout the microscopic field was a fine fibrillar stroma, which stained brown with Van Giesen's method but which did not give the characteristic neuroglia stain with Mallory's hematoxylin-phosphotungstic acid method. The cells presented an alveolar arrangement and here and there were polarized in double rows about a central mass of finely granular material, assuming characteristic "rosette" formations. Some of the cells were somewhat larger in size, with mitotic figures, and an occasional giant cell could also be seen. A few pyriform cells whose cytoplasm extended outward in the form of delicate fibrillar processes were present. No mature ganglion cells could be found. Numerous thin-walled blood vessels were seen in the reticular network supporting the cellular elements. (Figs. 3 and 4.)

Case IV. Primary neuroblastoma arising in the wall of the jejunum with metastases in the adjacent mesenteric lymph nodes; reported by me in 1925.[19]

J. F., a white, male Russian 64 years old, was admitted to the Mount Sinai Hospital on December 17, 1924. The patient complained of severe epigastric pains and distress for several months, with occasional vomiting and marked constipation. No hematemesis or melena had been observed, but there had been great loss of weight and the patient was markedly emaciated. His heart was enlarged and the sounds were of poor quality. An indefinite resistance was felt in the left hypogastric region, but no distinct tumor mass could be palpated.

Roentgen ray examination revealed a partial obstruction high up in the small intestine.

An exploratory laparotomy was performed under local anesthesia by Dr. Berg. He found a neoplasm involving the jejunum, commencing about 7.5 cm. from the fossa duodenojejunalis and extending distally in the wall of the intestine for a distance of 8 cm. There were metastases in the adjacent mesenteric lymph nodes. Many small metastatic nodules were present on the serous surface of the jejunum, just adjacent to the main tumor. Twenty-two cm. of the jejunum were resected, together with a portion of the mesentery, containing the tumor and enlarged glands. An end-to-end anastomosis was then made in the usual manner. The

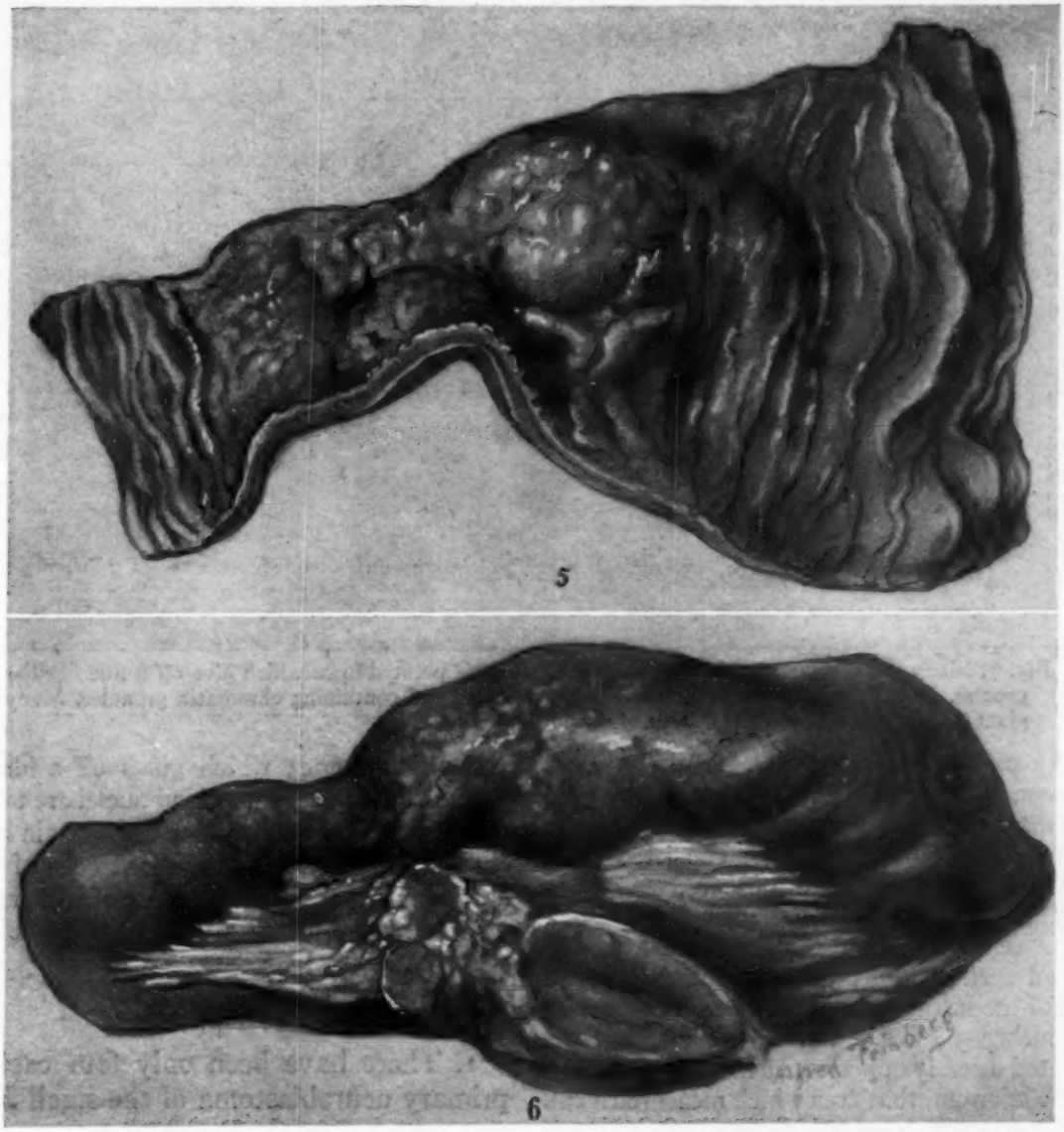


Fig. 5. Mucosal aspect of tumor arising in wall of jejunum, showing irregular nodular formation.
Fig. 6. Same case, showing the tumor infiltrating the serosal surface of the jejunum, mesentery and lymph nodes.

omentum was sutured over the anastomosis with interrupted catgut sutures and the abdomen closed without drainage.

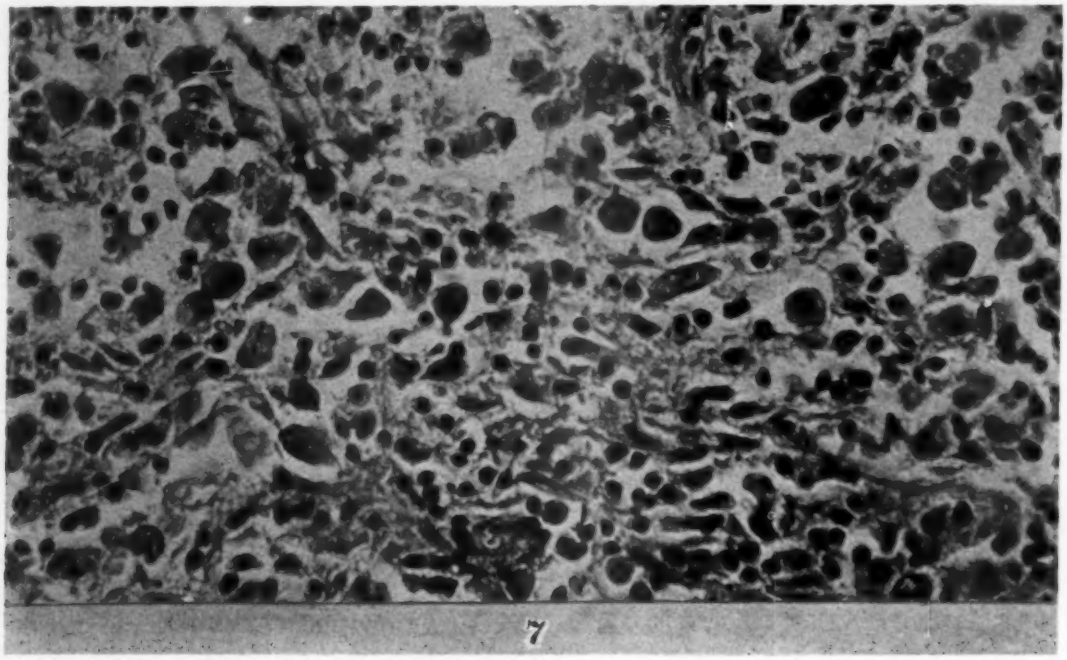


FIG. 7. Many pyriform-shaped cells with round base and pointed apex which give off a fine fibrillar process. Deeply stained nuclei oval in shape, vesicular and containing chromatin granules. Many giant cells, some with mitotic figures. (Low power.)

The patient made an uneventful recovery. His condition improved very rapidly and he was discharged from the hospital.

The macroscopic specimen consisted of a portion of jejunum which measured 22 cm. in length, 9 cm. in its widest diameter, and 4 cm. in its narrowest diameter. Attached to the serosal surface infiltrating the mesentery and wall of the intestine there was a cellular growth measuring 5 by 2.5 cm. This neoplasm was situated directly opposite the narrowest portion of the jejunum, that area which measured 4 cm. in diameter. It involved the wall of the intestine at this point and extended distally for a distance of 8 cm. The mucosa of the involved portion of intestine was irregular, nodular and firm. On the serosal surface there were several small, round or oval, firm, neoplastic elevations which on section were similar to the main neoplasm. (Figs. 5 and 6.)

Upon microscopic examination the tumor appeared to be made up of small, round "lymphoid" cells whose nuclei stained deeply and contained chromatin granules. The stroma of the tumor was composed of a fine, irregular diffuse, fibrillar network which did not give the characteristic neuroglia stain. Scattered throughout the microscopic field there were many pyriform-shaped cells with round base, and pointed apex which gives off a fibrillar process. Their deeply staining nuclei are oval in shape, vesicular in character and contain many chromatin granules. Many giant cells of variable sizes are also present, some of which show mitotic figures. They are not of foreign body variety. (Fig. 7.)

SUMMARY

1. There have been only four cases of primary neuroblastoma of the small intestine reported in the literature.

2. In all instances the tumors arose in persons past middle age.

3. In one case (Cames and Cid's), there were no metastases, the tumor being only locally malignant. In Fererro's case there were metastases in the mesentery and in the liver. In both cases reported by me there were metastases only in the adjacent mesenteric lymph nodes.

4. The observations indicate that primary neuroblastoma infrequently arises

from the Meissner's and Auerbach's plexus in the wall of the small intestine.

5. These cases emphasize the necessity for careful histologic study of atypical tumors, which on first examination might appear to be sarcomatous in character. It is probable that for this reason other instances of neuroblastoma of the intestine have been classified as sarcomata.

REFERENCES

1. Kohn, A. Ueber die Entwickelung des peripheren Nervensystems. *Anat. Anz., Supp.*, 27: 145, 1905.
2. Marchand. Beitr. z. Kenntnis des Glandula carotica und der Nebennieren. Festchr. f. R. Virchow; Internat. Beit. z. Wissench. Med. Berlin, 1: 578, 1891.
3. Kuster. Ueber Gliome der Nebennieren. *Virchows Arch. f. path. Anat.*, 170: 117, 1905.
4. Wiesel. Bermerkungen zu der Arbeit H. Kusters, ueber Gliome der Nebennieren. *Virchows Arch. f. path. Anat.*, 180: 553, 1905.
5. Wright, J. H. Neurocytoma or neuroblastoma. A kind of tumor not generally recognized. *J. Exper. Med.*, 12: 556, 1910.
6. Landau. Das Ganglioma embryonale sympatheticum. *Frankfurter Ztschr. f. Path.*, 11: 26, 1912.
7. Pick and Bielchowsky. Ueber das System der Neurome. *Ztschr. f. d. Ges. Neur. u. Psych.*, 6: 391, 1911.
8. Pick. Das Ganglioma embryonale sympathicum. *Berl. klin. Wchnschr.*, 49: 16, 1912.
9. Wahl, H. R. Neuroblastoma with study of a case illustrating three types. *J. Med. Research*, 30: 205, 1914.
10. Harbitz, F. Tumors of the sympathetic nervous system and the medulla of the adrenal glands, especially malignant neuroblastoma. *Arch. Int. Med.*, 16: 312, 1915.
11. Lehman, E. P. Neuroblastoma with report of a case. *J. Med. Research*, 36: 309, 1917.
12. Lambert, R. A. Report of a case of neuroblastoma. *Proc. Path. Soc.*, 17: 96, 1917.
13. Wolbach and Morse. Neuroblastoma sympatheticum. Report of case with notes on two others, and brief review of the literature. *Am. J. Dis. Child.*, 16: 63, 1918.
14. Martius. Maligner Sympathoblastentumor des Halssympathikus teilweise ausdifferenziert zu gutartigem Ganglioneurom, *Frankfurter Ztschr. f. Path.*, 12: 442, 1913.
15. Dunn. Neuroblastoma and ganglioneuroma of the suprarenal. *Arch. Int. Med.*, 16: 341, 1915.
16. Gunby, P. C. Neuroblastoma sympatheticum. Report of one case. *Am. J. M. Sc.*, 160: 207, 1920.
17. Anderson, J. S., and Shennan. Neuroblastoma of thoracic cavity. *J. Path. & Bacteriol.*, 26: 545, 1923.
18. Askin and Geschickter, G. Neuroblastoma of adrenal in children. *J. Pediat.*, 7: 157, 1935.
19. Ritter, S. A. Neuroblastoma of the intestine. *Am. J. Path.*, 1: 519, 1925.
20. Ferrero, V. Neuroblastoma malign del intestino tenue. *Arch. per le sc. med.*, 45: 114, 1922.
21. Cames, O., and Cid, J. M. Benign neuroblastoma of the jejunum. *Prensa med. argent.*, 20: 1485, 1933.
22. Meltzer, Sara. Neuroblastoma occurring in adults. *Canad. M. A. J.*, 16: 647, 1926.

POSTOPERATIVE EVENTRATION

HAROLD BELLIN, M.D.

ALBANY, NEW YORK

POSTOPERATIVE eventration, while not very common, occurs often enough to present a real problem to the surgeon. Eliason and McLaughlin report twenty-five cases out of a total of 9,155 abdominal operations, or about 0.27 per cent. Starr and Nason report fifteen cases in 2,445 laparotomies, or 0.61 per cent. Menley and Howes report fifty-five cases, and estimate that this catastrophe occurs in about 1 to 2 per cent of their cases. Colp reports twenty-nine cases in 2,750 laparotomies, or 0.9 per cent, and Koster and Kasman report seventeen in 7,892 operations, or 0.22 per cent. Beltman and Lichtenstein found thirty-two cases in 12,445 (0.25 per cent). Maes, Boyce and McFetridge encountered forty-four cases in a ten-year period. Milbert noted three cases out of 1,560 laparotomies. At the Memorial Hospital, Albany, New York, there were four cases in 1,812 laparotomies, or 0.2 per cent.

On the other hand, Baldwin, after 16,465 laparotomies over a thirty-five year-period, states that he has had no disruptions. Kennedy also reports a similar finding in his experience.

Some authors present only cases of complete eventration, while Milbert believes that all cases of wound disruption, where there is a failure of any of the tissue planes to hold satisfactorily, should be included. He reports twenty cases of imperfect wounds, of which only three could be classified as eventration. Many include appendectomies and herniotomies in their study, while others omit these types of cases.

Etiology. There is a great deal of contradiction as to the causes of this complication. Eliason and McLaughlin enumerate as the contributing factors such things as improper closure, too early discontinuance of the anesthesia, over-energetic use of carbon dioxide, unusually stormy postoperative course, too early dissolution of non-infected material, wound infections, age, disability and cachexia.

Von Graff states that the predisposing causes are senility, decrepitude, malignancy, jaundice, obesity and anemia, and cites as active causes constant coughing, hiccoughing, sneezing, distention, undue abdominal strain, and infection. He believes that disturbance of carbohydrate metabolism is an important cause, having found a diabetic condition in four successive cases, as revealed by blood sugar and sugar tolerance tests.

Glasser places great stress on increased abdominal tension. Lahey believes that inadequate hemostasis and hematoma are the underlying causes of this complication.

Menely and Howes believe that sex, anesthesia, type of incision, magnitude of the operation, method and technique of closure, and drainage and wound infection, bear little or no relationship to postoperative eventration. They believe there is a failure of the regenerative powers of the tissues to promote firm healing. Neither these men, nor any others who believe in the lack of regenerative powers explain why, after eventration has taken place and secondary suture is undertaken, the wound subsequently heals. It seems that if there were a lack of regenerative powers in the first instance, the same condition prevailing, the wound would fail to heal a second time. There are no reports available in the literature of a recurrence of eventration following secondary suture.

Boland reports a smaller frequency of occurrence in the colored race.

White states that he has never seen this complication following intermuscular, Pfannenstiehl, costal or transverse incisions.

Beltman and Lichtenstein have noted eventration after lower midline incisions, but report that its occurrence does not run parallel with poorly healing wounds, which would detract from the theory of infection. They also remark upon the sporadic occurrence of cases and definite grouping at certain irregular intervals.

Maes, Boyce and McFetridge state that no surgeon is safe from the catastrophe regardless of excellence of technique. They believe Freeman's theory of the mechanism of wound rupture the most reasonable of any so far advanced. Freeman states: "There is an opening of the peritoneal layer, which may be present as the result of inadequate closure, and a wedge of peritoneum protrudes immediately postoperative. This protrusion becomes larger and larger until finally the entire wound is disrupted." Freeman and Sims independently produced this condition in the laboratory.

Hinton advances the theory of allergy as a cause of wound disruption.

Symptoms and Signs. The symptoms of this complication may be persistent or late vomiting. The first indication of its occurrence, however, may be a slight serous discharge upon the dressings followed soon after by a disruption of the wound and the protrusion of the abdominal contents.

The complication usually occurs between the fifth and ninth days after operation.

Treatment consists of either tamponing the contents and drawing the incision closed with adhesive, or in immediate secondary suture. Reid, Zinninger and Merrill recommend through-and-through silver wire. However, any type of non-absorbable sutures, of sufficient tensile strength may be used. The chief objective is to recognize the condition early, and submit the patient to as little shock as possible. It is for this reason that through and through sutures are used, instead of suturing each tissue plane separately.

Prophylaxis. Baldwin leaves his retention sutures in for a full fourteen days, following which he supports the wound with adhesive or many tailed binders for a length of time, sufficient to allow the incision to heal firmly.

Beltman and Lichtenstein, however, report ten cases of eventration occurring between two tension sutures.

Since wound disruptions generally occur previous to the tenth or eleventh day, it seems that Baldwin's precaution is a wise one. This, together with adequate approximation of the peritoneal layer, may prevent eventration from occurring.

Heyd recommends complete hemostasis, complete relaxation while closure is being performed, avoidance of undue trauma, elimination of dead space, absolutely aseptic technique and accurate coaptation of peritoneum. He further believes that the split muscle should be sutured.

Kennedy recommends through-and-through silkworm gut sutures, three to the inch, which he removes on the ninth or tenth day.

At the Memorial Hospital, from 1929 to 1935 inclusive, there were 1,812 abdominal operations, in which four cases of post-operative eventration occurred. Secondary through-and-through sutures were done, after which three patients made a full recovery, while the fourth died of pneumonia. It is a question whether the pulmonary condition was not present before the disruption, and really the primary cause of the death. Two cases were those of one operator, and the other two cases were each done by a different surgeon.

Obesity was present in two cases. There were three men and one woman, whose ages were 53, 46, 37 and 63 respectively. Eventration occurred eleven days, eight days, eight days and nine days after operation. Pathologic processes present were adenocarcinoma of the gall-bladder, multiple gastric ulcers, intestinal adhesions, cholecystitis, and appendicitis.

CASE REPORTS

Case 1. J. T., age 63, male, Italian laborer, was admitted to Memorial Hospital on March 6, 1929, and operated on March 7, 1929, with

a preoperative diagnosis of malignancy or inflammatory condition of the gall-bladder.

On March 7, under spinocaine, through a right rectus incision, an exploratory operation was performed, adenocarcinoma was diagnosed, and a small piece of tissue was removed for laboratory confirmation. Closure was done by layers, and silkworm gut stay sutures were used.

On March 16, eventration took place. The patient was immediately brought to the operating room, and gas and oxygen anesthesia was administered. Preoperative note: "The incision was wide open from top to bottom. The transverse colon was out on the abdominal wall. At the upper part of the wound the greater omentum had insinuated itself into the wound, wedging it apart. The wound edges showed no signs of healing." The entire abdomen and the intestines were painted with acriflavine. The intestines were returned to the abdomen, the wound closed by through-and-through silkworm gut sutures, and one cigarette drain inserted.

The patient was discharged from the hospital on April 23, 1929.

Case II. S. E., age 53, white male, was admitted April 10, 1929 with a diagnosis of carcinoma of the stomach.

On April 25, 1929, under gas oxygen anesthesia, a partial gastrectomy (Moynihan #2) was performed. A midline incision was used. Closure was with silkworm gut. No drainage used. The postoperative diagnosis was multiple gastric ulcers.

On May 6, 1929, the incision (above the umbilicus) was wide open with omentum filling the gap. Under ethyl anesthesia, the wound was prepared with acriflavine; the omentum was pulled from the wound edges, and returned to the abdomen. The peritoneum was closed with continuous No. 2 chromic catgut, the fascia with interrupted and the skin with continuous sutures of the same material. One rubber drain was inserted. Through-and-through silkworm gut sutures were used.

The patient was discharged May 27, 1929, improved.

Case III. Mrs A. C., age 46, white, obese farmer, was admitted to Memorial Hospital on May 6, 1930.

On May 17, under ether anesthesia, an anterior and posterior colporrhaphy was done and adhesions below the descending colon and sera of a previous vaginal hysterectomy were abdominally released.

On May 25, the abdominal wound was entirely opened, and the colon and intestines were lying on the anterior abdominal wall. The patient was brought to the operating room, and after the wound areas were prepared with mercurochrome, the edges were injected with novocaine, and through-and-through silkworm gut sutures were used to close the incision. Except for a marked ileus which was treated conservatively with pituitary extract and enemas, she made an uneventful recovery.

She was discharged from the hospital on July 2, 1930, cured.

Case IV. J. E. C., age 37, male, white, obese, was admitted February 5, 1935, with a diagnosis of chronic cholecystitis, pericholecystitis, chronic appendicitis, and periappendicitis with adhesions.

On February 6, under avertin ether anesthesia, and through a right rectus incision, appendectomy and cholecystectomy were performed. One cigarette drain and one rubber tube were used.

On February 14, following severe coughing, the incision opened. At 4:50 A.M., the patient was brought to the operating room, and under gas and ether anesthesia, an approximation of the layers with through-and-through silkworm gut was done. Preoperative note: "The wound was open throughout entire length, the large and small bowel lying outside the abdomen. Tissues show very poor attempt at healing and are brittle and soft." An attempt was made to close layer by layer, but as a result of protrusion and soft tissues, through-and-through suture had to be done. No drainage was used.

Patient expired on February 15, 1935, at 7:25, due to a right-sided pneumonia.

SUMMARY

1. Postoperative disruption of wounds, occurring early (within eleven days) may result in eventration.

2. There is no agreement as to the cause of this complication.

3. Immediate repair follows the best surgical principles.

4. Adequate closure of peritoneum with prolonged stay of tension sutures may prevent this complication.

5. Four cases of eventration are presented.

I wish to thank Drs. A. M. Dickinson, C. G. Hacker, and A. B. Van Loon, for permission to report their cases.

REFERENCES

Baldwin, J. F. Disruption of abdominal wounds. *Am. J. Surg.*, 25: 7, 1934.

Beltman, R. B., and Lichtenstein, G. M. Evisceration following abdominal operations. *Arch. Surg.*, 32: 721, 1936.

Boland, F. K. Postoperative evisceration in the colored race. *South. M. J.*, 29: 1225, 1936.

Colp, Ralph. Disruption of abdominal wounds. *Ann. Surg.*, 99: 14, 1934.

Eliason, E. L., and McLaughlin, C. Postoperative wound complications. *Ann. Surg.*, 100: 1159, 1934.

Freeman, L. The cause of postoperative rupture of abdominal incisions. *Arch. Surg.*, 14: 600, 1927.

Glasser, S. T. Evisceration and avulsion of abdominal wounds. *Am. J. Surg.*, 31: 63, 1936.

Grace, R. U. Disruption of abdominal wounds. *Ann. Surg.*, 99: 28, 1934.

Heyd, C. G. Disruption of abdominal wounds. *Ann. Surg.*, 99: 39, 1934.

Hinton, J. Wm. Allergy as an explanation of dehiscence of a wound and incisional hernia. *Arch. Surg.*, 33: 197, 1936.

Kennedy, J. W. Tragedies of the abdominal incision. *Am. J. Surg.*, 25: 512, 1934.

Koster, H., and Kasman, L. P. Wound disruption. *Am. J. Surg.*, 31: 537, 1936.

Lahey, F. H. The management of some complications following abdominal operation. *J. A. M. A.*, 89: 1735, 1927.

Maes, U., Boyce, F. F., and McFetridge, E. M. Postoperative evisceration. *Ann. Surg.*, 100: 968, 1934.

Meleney, F. L., and Howes, E. L. The disruption of abdominal wounds with the protrusion of viscera. *Ann. Surg.*, 99: 5, 1934.

Milbert, R. H. A study of disruptions of abdominal wounds. *Arch. Surg.*, 31: 86, 1935.

Reid, M. R., Zinninger, M. M., and Merrell, P. Closure of abdomen with through-and-through silver wire sutures in cases of acute abdominal emergencies. *Ann. Surg.*, 98: 890, 1933.

Sims, H. J. The case of postoperative rupture of abdominal wounds. *Colorado Med.*, 32: 717, 1935.

Starr, A., and Nason, L. H. Postoperative rupture of abdominal wounds. *J. A. M. A.*, 100: 310, 1933.

Von Graff, Erwin. Etiology, diagnosis and treatment of evisceration following laporotomy. *Am. J. Obst. & Gynec.*, 31: 754, 1936.

White, W. C. Disruption of abdominal wounds. *Ann. Surg.*, 99: 34, 1934.

INTESTINAL OBSTRUCTION FOLLOWING WEBSTER-BALDY OPERATION FOR UTERINE RETROVERSION

LAWRENCE E. ARNOLD, M.D.

Attending Surgeon, St. Paul's Hospital

DALLAS, TEXAS

ATTENTION long has been called to the danger of hernia through the broad ligament following Webster-Baldy operation for uterine retroversion, but a survey of the literature fails to sustain the reputed high incidence of this sequela. In the two cases reported in the literature, herniation was due to the operator's failure to follow the original description of the operation by Webster. In 1901, Webster[1] stated that the round ligament should be brought through the broad ligament adjacent to the uterus and below the utero-ovarian ligament; he further specified that the round ligament should be sutured securely to the broad ligament at the point of perforation, and that the round ligaments should be joined and sutured to the posterior surface of the uterus just above the uterosacral ligaments.

Richardson,[2] in 1920, reported a case in which the round ligament was drawn through the broad ligament at a point too far distant from its uterine insertion; the traction of the round ligament on the thin broad ligament produced an aperture through which small intestine herniated and produced intestinal obstruction. This tearing of the broad ligament caused a recurrence of uterine retroversion. There was no pregnancy between the time of suspension and the time of obstruction. The herniated loop of bowel was freed by salpingo-oöphorectomy; resection was unnecessary.

Pemberton and Sager[3] reported a similar case in 1929, caused by failure to suture the round ligament to the broad ligament at the point of perforation. On the twenty-fourth post-operative day symptoms of intestinal obstruction developed. The bowel had herniated from posterior to anterior through the broad ligament about 2 meters from the ileocecal valve.

Pemberton and Sager[3] reported another case in 1929 in which there was no intestinal obstruction, but bilateral apertures were noted in the broad ligaments. These defects were found when laparotomy was performed to remove a large fibromyomatous uterus; each hole admitted two fingers. The defects were undoubtedly caused by the markedly increased tension on the broad ligaments by growth of the fibromyomata. Suspension had been performed twelve years previously.

Searle,[4] in 1934, showed that herniation and obstruction were not confined to the Webster-Baldy type of operation. He reported a fatal case of intestinal obstruction in which the ileum became locked between the uterus and the abdominal wall following ventral fixation operation for uterine retroversion. This complication could have been prevented by completely obliterating the space between the uterus and the abdominal wall.

In 1936 Michael[5] reported two cases of intestinal obstruction following the Gilliam type of suspension, in both of which the ileum had become locked between the round ligament and the abdominal wall. As a means of preventing this sequela he suggested that the space between the distal portion of the round ligament and the abdominal wall be obliterated by suturing these two structures together.

CASE REPORT

The patient, Mrs. O. E. S., a biparous female, aged 34 years, entered St. Paul's Hospital at 1:30 A.M. on June 1, 1937, complaining of severe, generalized abdominal pain, obstipation, nausea, and emesis. These symptoms had

appeared suddenly twenty hours previously and had become progressively worse until time of admission. Several enemata had returned clear and had afforded no relief; the pain had become more pronounced in the right lower quadrant of the abdomen.

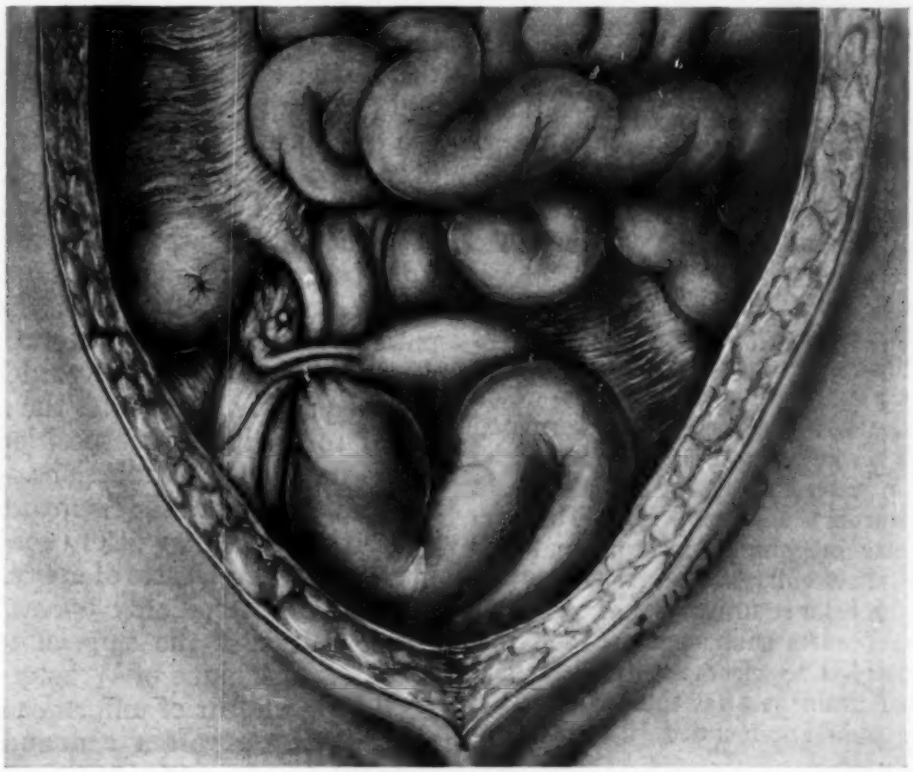


Fig. 1. Herniation through right broad ligament.

Nine years previous to admission the patient had undergone, in another city, during a period of three months, tonsillectomy, thyroidectomy, appendectomy, left salpingo-oöphorectomy, and Webster-Baldy suspension of the uterus. These operations had been undergone five years following the birth of her first child. Two years after her laparotomy a male child weighing 3,855.5 Gm. (8½ pounds) was born. Nine months after the birth of this child she experienced her first attack of intestinal obstruction; these attacks had recurred at intervals of approximately six months and each attack had been worse than the preceding one. The patient had been under the care of an internist during the previous several months for a polyglandular deficiency; she had been receiving thyroid, pituitary, and ovarian extract therapy.

Examination revealed a well developed but poorly nourished white female of stated age with height of 155 cm. (62 inches) and weight of 45.9 kg. (100 pounds); she was in a cachectic state and in obvious pain.

Mucous membranes revealed anemia graded one; the systems above the diaphragm were otherwise of no significance. The abdomen was distended to grade four with generalized tenderness of the same degree; the right lower quadrant was the site of greatest tenderness. Loud borborygmi were heard throughout the abdomen and each wave was accompanied by pain. Blood pressure was 108 systolic and 64 diastolic. Temperature was 38.0°C. (100.4°F.); the pulse rate was 104 beats per minute. There were 3,696,000 erythrocytes and 12,320 leucocytes in each cubic millimeter of blood; the value for hemoglobin was 10.8 Gm. per 100 c.c. of whole blood. The sedimentation rate of erythrocytes was 30 mm. per hour. Urinalysis gave negative findings.

A diagnosis of low complete intestinal obstruction was made and the patient was prepared for laparotomy by duodenal drainage, cleansing enema, subcutaneous injection of one liter of physiologic saline solution and 1 c.c. of pitressin, and intravenous injection of one-half liter of 10 per cent glucose solution.

The abdomen was opened through a low median line incision under nitrous oxide-ethylene anesthesia. Entrance into the peritoneal cavity disclosed distended and hyperemic ileum and 400 c.c. of serosanguinous transudate were aspirated. The appendix, left oviduct, and left ovary were found to have been previously removed; the round ligaments had been drawn through the broad ligaments and were attached to the lower posterior aspect of the uterus, which lay anteriorly on the bladder and occupied a high position in the pelvis.

At the point where the right round ligament had been drawn through the broad ligament 4 cm. lateral to its uterine insertion was found an aperture 2 cm. in diameter, through which 45 cm. of ileum had herniated. The herniated loop passed through the broad ligament from posterior to anterior with the most distal point 20 cm. from the ileocecal valve. This loop was in a late pregangrenous state and was withdrawn after enlarging the aperture by incision. A fair color returned to the bowel after application of warm saline packs and it was therefore decided to close without resection, ileostomy, or drainage after the defect in the broad ligament had been closed with a mattress suture.

The patient made an uneventful recovery with no trace of nausea, emesis, or pain; feces were passed without aid on the day following operation. She was discharged as recovered on the fourteenth postoperative day and has consistently gained weight and strength since the operation.

COMMENT

We still have no true indictment against the Webster-Baldy operation from the standpoint of intestinal obstruction if the operation is performed as originally described by Webster.[1] We now have record of two cases of obstruction caused by drawing round ligaments through broad ligaments too far distant from the uterus; we have one case caused by failure to suture round ligaments to broad ligaments at point of perforation. The second case of Pemberton and Sager[3] is not strong evidence against the operation because there was no intestinal obstruction present and the apertures were produced by the prolonged growth of large uterine fibromyomata.

One often hears that the results of the Webster-Baldy suspension are destroyed by subsequent pregnancy; the above case would tend to refute this theory. The patient carried a child to term two years after suspension and delivered it without difficulty; seven years later the uterus was found to be in perfect position and the pelvis was free from adhesions.

From a survey of the literature up to the present time we may safely conclude that in certain selected cases of uterine retroversion the Webster-Baldy operation is safe and effective; if the surgeon follows the operative technique of Webster closely he need have no fear of unfortunate sequelae and he may expect a permanent uterine anteversion.

REFERENCES

1. Webster, J. Clarence. A satisfactory operation for certain cases of retroversion of the uterus. *J. A. M. A.*, 37: 913 (Oct. 5) 1901.
2. Richardson, Edward P. Intestinal obstruction following Baldy-Webster operation for retroversion; report of case. *Surg., Gynec. & Obst.*, 31: 90 (July) 1920.
3. Pemberton, John, and Sager, Warren W. Intestinal obstruction following the Webster-Baldy operation for retroversion. *Surg. Clin. North America*, 9: 203 (Feb.) 1929.
4. Searle, W. N. Commentary on operative treatment of prolapse with report of death from intestinal obstruction after ventral fixation. *J. Obst & Gynaec., Brit. Emp.*, 41: 69–77 (Feb.) 1934.
5. Michael, M. A. Internal hernia following round ligament suspension; report of two cases, *J. A. M. A.*, 107: 1293–94 (Oct. 17) 1936.

THE SURGICAL TREATMENT OF DELAYED ULNAR NEURITIS

JAMES R. REGAN, M.D., F.A.C.S.

Department of Orthopedic Surgery, Veteran's Administration Hospital

MILWAUKEE, WISCONSIN

THE study of delayed ulnar neuritis is extremely interesting for several reasons: (1) the mode of the development of the condition; (2) the ease of treatment; and (3) the remarkable success attained by surgical intervention.

Peripheral nerves, by reason of their intrinsic elasticity, are able temporarily to increase their length without any untoward effects. However, when a peripheral nerve is subject to prolonged and constant distortion or elongation, a neuritis is usually the end result. Such distortion and elongation not uncommonly occurs to the ulnar nerve because of its position in relation to the elbow joint.

It was formerly held that the condition was not very common. However, the writer has seen eleven cases within the past four years, seven of which are here reported with their end results. The remaining four have been too recently treated to permit of evaluation of results at this time. It is true that probably more cases will be found during this or the next decade, but it is the opinion that in time the neuritis resulting from a distortion at the elbow joint, due to injuries sustained in early life, may become extinct. This opinion is based upon several premises: first, the rapid progress in the treatment of fractures since the early portion of the century; second, the greater use and facility of the Roentgen ray in the diagnosis of injuries, which procedure was not present to any degree at the turn of the century; and third, the ability of the general public to appreciate early treatment in injuries to bone.

There are many case reports in the literature concerning delayed neuritis, the result of untreated or poorly treated fractures about the elbow joint, especially in children, with the subsequent development of an ulnar nerve palsy many years after the original injury. Platt has classified the following types of neuritis, traumatic in origin which may affect the ulnar nerve adversely:

I. Primary neuritis
   - *a*) Following simple contusions
   - *b*) Complicating:
     1. Internal epicondylar fractures
     2. Supracondylar fractures
     3. Acute dislocation of the elbow

II. Secondary neuritis
   - *a*) Complicating:
     1. Fractures of the lower end of the humerus
     2. Dislocations of the elbow joint

III. Delayed neuritis
   - *a*) Subsequent to fracture of the external condyle of the humerus with malunion
   - *b*) Subsequent to repeated dislocation of the nerve

The last named groups of so-called delayed ulnar neuritis have probably been observed from time immemorial. Lately Conway[1] has reported a case and has completely surveyed the subject historically, calling attention to the fact that very often a neuritis may be set up by an anomalous hypermobile nerve which slips forward on the medial epicondyle when motion at the elbow joint takes place. Panas[2] described the condition first in 1878. Mouchet,[3] in 1898 and in later papers, presented a most complete investigation of the subject and drew attention to the fact that this type of neuritis followed fractures of the external condyle of the humerus which were followed by malunion and deformity. Since Mouchet's work there

have been many interesting discourses on the subject.

MODE OF THE DEVELOPMENT OF THE NEURITIS

Distortion of the nerve at the elbow is necessary for the development of a delayed neuritis. Of course it is probable that all individuals with a distortion of the ulnar nerve at the elbow may not develop this typical neuritis, as the elasticity of peripheral nerves differs in certain individuals, as does the power of formation of scar tissue. The distortion can be due either to fractures which increase the carrying angle, causing the typical cubitus valgus deformity, or to a recurring dislocation of the nerve. The typical and most common finding is that of fracture of the external condyle occurring in early life with the insidious development, often twenty to thirty years after the original injury, of the ulnar neuritis. Mouchet believed that the neuritis could not be associated with any other fracture. However, the author reports a case (Case IV) in which the distortion at the elbow was due to an unreduced upward dislocation of the head of the radius. Supracondylar fractures, which malunite with an increase of the water carrying angle, also have been known to cause the neuritis.

The most common fracture about the elbow joint in children is that of the external condyle with extension into the joint and with a resultant distraction of the smaller fragment due to the pull of the powerful extensor muscles. Union may often occur by fibrous tissue only. The deformity becomes greatly exaggerated in later life because of the uneven epiphyseal growth. The resultant cubitus valgus deformity forces the ulnar nerve to be stretched while the elbow is at rest and with each motion of flexion. This sets up a perineuritis with an overgrowth of connective tissue which may even encroach upon the nerve fibers, causing a compression neuritis and giving rise to the typical picture of an ulnar palsy late in life.

CLINICAL COURSE

The findings in a well developed case of ulnar palsy differ, of course, in degree and severity. The usual findings are no different from those encountered in a complete or incomplete lesion of conduction of the ulnar nerve.

1. There is the typical claw hand due to paralysis of the two inner lumbricales and all of the interossei muscles.
2. Weakness in adduction and flexion of the wrist due to paralysis of the flexor carpi ulnaris muscle.
3. Decreased power in flexion of the small and ring fingers due to paralysis of the inner half of the flexor digitorum profundus muscle.
4. Weakness in adduction of the thumb and paralysis of the small muscles of the fifth finger. Paralysis of the palmaris brevis and flexor pollices brevis muscles.
5. Atrophy of the thenar and hypothenar eminences as well as the interosseous spaces.
6. Anesthesia, epicritic in origin, of the inner side of the dorsum of the wrist and of the palm and of the small and ring fingers; usually, loss of protopathic sensation.
7. Vasomotor disturbances over the area supplied by the ulnar nerve, usually atrophy of the skin with prominence of the follicles, often hyperkeratosis of the nails of the ring and small fingers, atrophy of the skin often with loss of hair on the dorsum of the hand in the ulnar portion.

The length of time for development, and the severity of the condition differ in different individuals. One of the cases to be reported had a symptomless period of thirty-five years between the time of injury and the onset of the neuritis. The severity of the neuritis does not seem to depend upon the severity of the deformity at the elbow. However, the length of time between the occurrence of symptoms and the institution of treatment is important as regards end results. The earlier treat-

ment is instituted, the earlier will there be complete relief.

The symptom ushering in the neuritis also varies. (See Table 1.) Usually, the motor phase of the neuritis overshadows the sensory phase. It is pertinent to note that none sought relief for the conspicuous deformity at the elbow. The progress is rather rapid once the neuritis sets in.

TABLE I

Case	Age, Years	Cause	Age at Initial Injury	Age at Which Symptoms Occurred, Years	Latent Period	First Symptom	Time between Appearance of Symptoms and Treatment	Treatment	Result
1. D. F.	39	Fracture external condyle	4 years	36	32 years	Pain and paresthesia	3 years	Neurolysis	Relief in 1 year.
2. H. R..	36	Fracture external condyle	5 years	35	30 years	Weakness of hand grasp	1 year	Neurolysis	Relief in 1 year.
3. C. C..	42	Dislocating nerve	No injury	41	Unknown	Anesthesia and atrophy	1 year	Neurolysis	Relief in 1 year.
4. T. E.	46	Upward dislocation of radius	7 years	42	35 years	Weakness and atrophy	4 years	Neurolysis	Relief prolonged 2½ years.
5. F. C.	31	Fracture external condyle	11 years	28	17 years	Weakness of hand grasp	3 years	Neurolysis	Relief in 2 years.
6. C. D.	40	Dislocating nerve	No injury	39	Unknown	Weakness and anesthesia	16 months	Neurolysis	Relief in 18 months.
7. G. P.	39	Fracture external condyle	8 years	38	30 years	Pain anesthesia and weakness	1 year	Neurolysis	Relief in 1 year.

TREATMENT

All are agreed that the treatment must be surgical in nature, the procedure being merely mechanical, that is, mere freeing of the ulnar nerve from its normal position behind the medial epicondyle and transplantation anteriorly in an effort to shorten the course of the nerve. This maneuver can be performed under infiltration anesthesia. After freeing the nerve from its position behind the medial epicondyle, the humeral origin of the flexor carpi ulnaris muscle is removed subperiostially as the nerve enters the forearm between the medial and lateral heads of this muscle. Following this, a tunnel is fashioned in the deep layer of the superficial fascia, the nerve placed within, and then the humeral head of the flexor carpi ulnaris muscle is resutured to its normal origin. Thus the course of the nerve is shortened and it is placed in the most likely position where scar tissue will not reform to compress it.

Several other methods of performing the neurolysis have been offered by various writers, namely: (1) mere freeing of the nerve without any transposition; (2) the performance of a supracondylar osteotomy in an effort to overcome the cubitus valgus deformity; or (3) saucerization of the dorsum of the medial epicondyle with replacement of the nerve in this area. These methods have all been dispensed

with for obvious reasons. The only method which has proved successful in the hands of nearly all operators has been the treatment as outlined above, namely: transposition of the nerve from its normal habitat behind the medial epicondyle to an anterior position on the elbow joint. The results obtained from this type of maneuver are uniformly successful. Usually in a short time, three weeks to two months after operation, sensation will slowly return, atrophy will rapidly disappear. The deformity, which usually is the last to disappear, clears up within eight to twelve months, depending, of course, upon the intrinsic power of the nerve to reëstablish nervous impulses.

Fig. 1. Case 1. Increased water-carrying angle of the right elbow. Note the deformity of the ring and small fingers.

CASE REPORTS

Case 1. D. F., age 39 years, entered the Veterans' Administration Hospital July 15, 1931. He complained of weakness in the grasp of the right hand. The entrance diagnosis was "early progressive muscular atrophy." The patient stated that three years before entrance into the Hospital he noticed tingling in the ring and small fingers. This was followed by rapid wasting of the muscles of the hand and progressive weakness. At the age of 4 years, the patient suffered an injury to the right elbow followed by a progressive deformity.

Examination revealed nothing abnormal except that the right arm showed a typical palsy of an ulnar nature. The patient had a deformity of the right elbow in which the water carrying angle was increased about 35 degrees. (Fig. 1.) The internal epicondyle was extremely prominent. The *x*-ray revealed an old fracture of the external condyle running obliquely into the joint with non-union and displacement of the radius and ulna upward. There was union between the head of the radius and the fragment of the external condyle. (Fig. 2.) Pressure over the ulnar nerve did not elicit any tenderness along its course nor cause any paresthesia over the ring or small fingers. The power of adduction and abduction of the fingers was lost. There was a severe atrophy of the hypothenar and thenar eminences with atrophy of the interosseous spaces. There was a typical claw hand, with loss of hair on the ulnar border of the dorsum of the hand. (Fig. 3.)

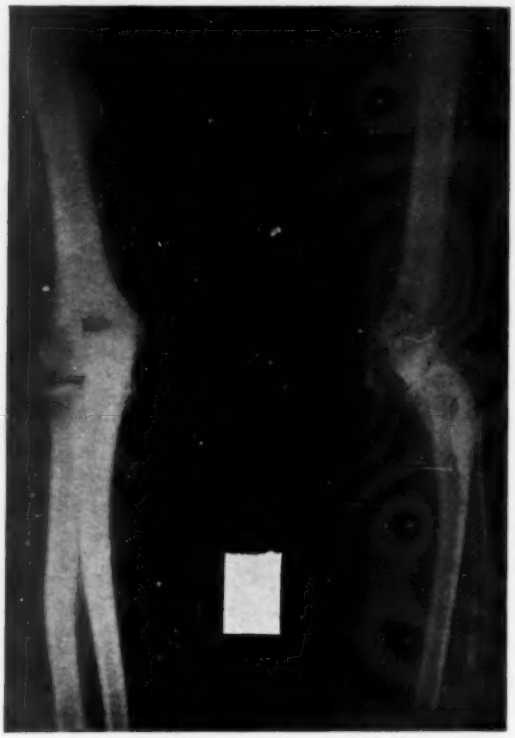


Fig. 2. Case 1. Roentgenogram of both elbows. Old fracture of the external condyle with upward displacement of the radius and increased carrying angle.

The diagnosis was delayed traumatic ulnar neuritis and operation was advised.

On July 25, 1931, under local novocaine infiltration anesthesia, a neurolysis was performed by the method mentioned. Three weeks

Fig. 3. Case 1. Typical deformity of the ring and small fingers combined with atrophy of the thenar and hypothenar eminences.

following the operation, numbness gradually disappeared and the excitability of the muscles supplied by the ulnar nerve began to increase. The deformity of the fingers gradually disappeared and when the patient was seen one year later there was full power in the hand, with no muscular atrophy and no sensory or vasomotor disturbances. (Fig. 4.)

Case II. H. R., age 36 years, entered the Veterans' Administration Hospital on September 1, 1932. The patient, an automobile mechanic by trade, stated that for the past year he had noticed that he could not grasp his tools without dropping them or holding them very loosely in the left hand. There was a history of injury to the left elbow at the age of 5 years, which was treated, according to the patient, by means of a sling and a wooden splint.

The examination was negative except for the left arm which showed a typical ulnar palsy with atrophy of the musculature supplied by the nerve, the deformity of the ring and small fingers and sensory disturbances. *X*-ray revealed a fracture of the external condyle with non-union, upward dislocation of the radius and ulna with a severe cubitus valgus deformity of almost 90 degrees.

On September 9, 1932, a neurolysis was performed under local anestesia. The ulnar nerve was greatly thickened and bound down by connective tissue. About one month following the operation, the patient stated he could feel some tingling in the finger tips of the small and ring fingers. One year following the operation all deformity had disappeared, and sensory and vasomotor disturbances had also faded.

Case III. C. C., age 42, entered the Vet-

Fig. 4. Case 1. Result one year following transplantation of the ulnar nerve. No deformity.

erans' Administration Hospital October 5, 1932 with complaints of numbness and tingling in the ring and small fingers. He stated that this had been present for the past year, but lately he had noticed that the grip of the left hand was not as strong as formerly and that his hand was wasting. The numbness had been brought to his attention some eight months previously when, while working on a band saw, he lacerated the inner border of the left hand while his attention was diverted, so that it was necessary for one of his co-workers to call his attention to the bleeding. He himself had felt no pain when the saw slipped into the hand.

Examination revealed a healed laceration on the inner border of the left palm. There was complete anesthesia extending from the wrist along the ulnar border and dorsum of the hand to the ring and small fingers, with no pain on pinching. There was a typical claw hand, with atrophy. (Fig. 5.) There was no deformity of the elbow joint and no history of injury. However, close questioning disclosed that the patient had for many years been able to force

the ulnar nerve anteriorly. He said he very often did this and could do it upon full flexion of the elbow. Up until about a year ago noticed a sharp knife-like pain in the ring and small fingers. The diagnosis of friction neuritis was advanced.

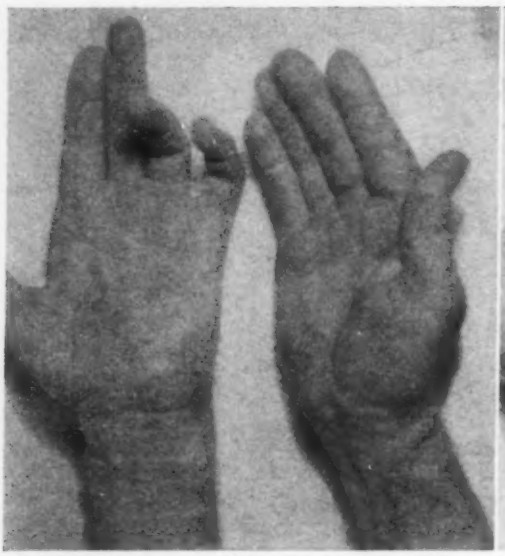


FIG. 5. Case III. Deformity of the ring and small fingers, the result of recurrent dislocation of the ulnar nerve at the elbow. Note the healed laceration on the ulnar border of the hand.

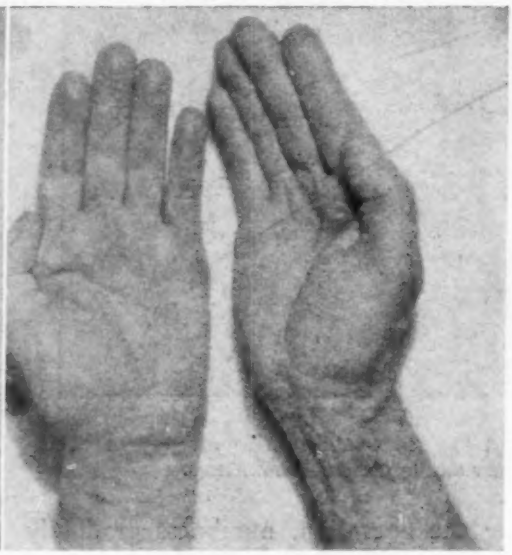


FIG. 6. Result one year after transplantation of the ulnar nerve. Note decreased deformity and improvement in the atrophy.

Under local novocaine infiltration anesthesia, the nerve was found to be loose and easily dislocated anteriorly; it was thickened and hyperemic. The sheath of the nerve was opened and a portion of it removed for microscopic examination. It proved to be infiltrated with connective tissue which was causing a compression upon the nerve. A neurolysis was performed. The patient was seen three months following the operation at which time the deformity of the ring and small fingers had disappeared, although there was still a slight amount of analgesia. The interosseous spaces were filling out as were the hypothenar and thenar spaces. When seen one year after the operation, no deformity existed and the musculature of the hand had returned to normal. There was no anesthesia or analgesia. (Fig. 6.)

CASE IV. T. E., age 46, entered the Veterans' Administration Hospital February 18, 1933 because of weakness of the right hand and wasting of the muscles. He stated that at the age of seven years he had fallen and injured his right elbow. Since he lived in a rural district, and no physician was available, the injury was treated by his parents by means of a splint. He had been symptomless up until about four years prior to entrance into the hospital, thirty-five years after the original injury. About four years before he noticed a few knife-like pains in the small and ring fingers, followed in about three months by an early wasting of the musculature and a beginning deformity of the ring and small fingers. Following this a rather severe weakness occurred and the deformity of the fingers became more and more progressive.

Examination dislosed extreme atrophy, the hand being rather badly involved. There was a serious deformity of the ring and small fingers, almost a complete flexion of the metacarpophalangeal joint. There was anesthesia and analgesia over the area of distribution of the ulnar nerve, and marked atrophy of the skin with hyperkeratosis of the finger nails.

X-ray revealed a fracture of the chip-like variety with full dislocation of the head of the radius upward, articulating with the external condyle. The deformity, cubitus valgus, was of about 20 degrees.

The diagnosis of late traumatic ulnar neuritis was advanced and on February 22, 1933, under local novocaine infiltration anesthesia a neurolysis of the ulnar nerve was performed. The ulnar nerve was greatly thickened and quite hyperemic and was bound down by bands of connective tissue. The postoperative course was without incident. The patient was followed

for three months and then lost sight of for two years. At the end of three months the deformity had greatly improved, the musculature was regaining its tonicity and the sensory disturbance was not quite so marked. When seen two and one-half years after operation there was slight deformity; the musculature, however, was equal to that of the right hand and there were no sensory disturbances.

Case v. F. C., age 31, entered the Veterans' Administration Hospital December 5, 1933. He complained of weakness combined with wasting of the left hand, and stated that he also felt some tingling in the small and ring fingers. The past history and examination were negative except for the following: at the age of 11 years he had fallen off a haymow, injuring the left elbow joint. He had no trouble except a deformity of the elbow joint up until about three and one-half years before examination, at which time he noticed a wasting of the muscles of the left hand combined with weakness. He stated that his hand was not numb, but it felt as if there were pins sticking into it at times.

Examination disclosed a deformity of the ring and small fingers of the claw-like variety with severe atrophy of the muscles of the hypothenar and thenar eminences and interosseous spaces. There was hyperesthesia, but no anesthesia was present. There was no true analgesia. The left elbow presented a severe deformity, the water-carrying angle being increased about 25 to 30 degrees. Diagnosis of late traumatic ulnar neuritis due to the cubitus valgus deformity of the elft elbow was made. *X*-ray revealed a fracture of the external condyle with non-union and upward displacement of the head of the radius with severe increase in the water-carrying angle.

On December 12, 1933, under local novocaine infiltration anesthesia, a neurolysis was performed. Two months following the operation, definite increase in the musculature was found and the deformity of the fingers slowly diminished. When the patient was seen two years following the operation, all atrophy had disappeared, full range of motion was present, there was a very slight deformity of the metacarpophalangeal joint, and a flexion deformity of about 10 degrees. No signs of anesthesia, etc., were present.

Case vi. C. D., age 40, entered the Veterans' Administration Hospital on March 5, 1934. He stated that for the past four months he had been noticing a wasting of the left hand. He was a bookkeeper by trade and could no longer hold the paper with the left hand, i.e., in grasping the paper between the index finger and the thumb it was necessary for him to exert a great deal of power and to flex the thumb in order to lift the paper from the desk.

There was a claw hand deformity of the ring and small fingers with complete anesthesia of the ring and small fingers and of the area supplied by the ulnar nerve. Severe muscular atrophy was combined with hyperkeratosis of the ring and small fingers. No deformity of the elbow existed. The patient stated that for some years since childhood he noticed that upon bending his elbow he felt sharp pains in the ring and small fingers and at the time of examination could easily dislocate the nerve anteriorly by a full flexion of the elbow. For the past three months he claimed that he did not feel the sharp knife-like pains when flexing the elbow. The diagnosis of friction neuritis due to recurrent dislocation of the ulnar nerve was made.

Operation was undertaken March 17, 1934, and a neurolysis was performed, and the nerve being found loose behind the medial epicondyle and thickened to almost twice its normal size. One month following the operation the patient felt a definite return of sensation in the fingers. There was a decrease in the anesthesia and some slight increase in the size of the muscles which had been atrophied. The patient was seen eighteen months following the operation, at which time all deformity had disappeared. There was full range of motion, normal power and no atrophy.

Case vii. G. P., age 39, entered the Veterans' Administration Hospital June 10, 1934. His entrance complaint was pain in the left ring and small fingers, which had gradually diminished. Soon after the lessening of the pain he had noticed that his hand became weak and that it began to waste. He said that no feeling was present on the inner side of the palm of his hand. The left small finger nail had fallen off several times within the past year, to be replaced by a rather horny-like nail.

Examination revealed a typical ulnar palsy of the left hand with severe atrophy and severe weakness. There was anesthesia over the area supplied by the ulnar nerve. There was a severe cubitus valgus deformity with prominence of the internal epicondyle. *X*-ray revealed a

fracture of the external condyle of the humerus with rotation of the fragment upward and some retraction of the radius upward. The fracture extended into the joint. Diagnosis of late traumatic ulnar neuritis was made, and on June 12, 1934, a neurolysis was performed.

The patient was seen one year following the operation, at which time he stated that about three months following the operation he noticed a return of sensation to the hand, coupled with gradual increase in the size of the hand and decrease of the deformity, with complete relief within the year.

SUMMARY AND CONCLUSIONS

1. Seven cases of delayed traumatic ulnar neuritis are reported, together with the mode of treatment and end-results.

2. The causative factor of the development of the neuritis is any condition which causes an increase in the water-carrying angle usually a fracture of the external condyle of the humerus in early childhood or repeated dislocation of the nerve causing a friction neuritis.

3. The degree of the severity of the neuritis does not seem to depend upon the degree of deformity at the elbow, several of the cases shown had only a mild to moderate cubitus valgus but the neuritis was of the extremely severe type, while others in whom the angle of deformity was great, the neuritis was not quite so severe.

4. The element of time is important. That is, the earlier a case is treated after the onset of the neuritis, the earlier will be the return of function.

5. The treatment is merely that of a transplantation of the ulnar nerve which thus shortens the course of the nerve.

6. Remarkable success is attained by this simple maneuver.

7. Rapid restoration of function is the usual rule.

REFERENCES

1. Platt, H. Pathogenesis and treatment of traumatic neuritis of the ulnar nerve in the post-condylar groove. *Brit. J. Surg.*, 13: 409–431 (Jan.) 1926.
2. Conway, F. M. Traumatic ulnar neuritis. *Ann. Surg.*, 97: 425–433 (March) 1933.
3. Panas, J. Sur une cause peu connue de paralysie du nerf cubital. *Arch. gén. de méd.*, vol. 2, 1878.
4. Mouchet, A. Fractures de l'extrémité inférieure de l'humérus avec radiographies. Paris Thesis 1898. Idem. Paralysie tardive du nerf cubital à la suite des fractures du condyle external de l'humérus. *J. de. chir.*, 12: 437, 1914.

THE REPAIR OF HERNIAS WITH RIBBON-GUT

SUMMARY OF TWENTY-SIX CASES*

G. AUBREY HAWES, M.D.

Assistant Resident, James Buchanan Brady Foundation, New York Hospital

NEW YORK CITY

THE purpose of this article is to report a series of twenty-six cases of hernias which have been repaired during the past three years by the use of ribbon-gut. The scope of this paper does not include a discussion of the different methods of repair of hernias, inasmuch as there are numerous articles in the literature describing and discussing the relative merits of the methods in general use to-day. As will be noted from the chart, twenty-four of the twenty-six cases were repaired by the Bassini technique. The number of ribbon-gut sutures used depended upon the length of the inguinal canal, three or four sutures being the average number. In one case (Case XII) the Halsted technique was used, and Case XXI, who had a large incisional hernia from a previous nephropexy, was repaired by approximating the fascia with interrupted ribbon-gut sutures; however, this repair was unsuccessful due to separation of the fascia on the twentieth postoperative day.

As regards the local complications following the repair, there were twenty-one cases, 80 per cent, in which no complications occurred; in three cases, 11 per cent, there was a small amount of purulent exudation from the wounds; one patient had a small collection of serum on the ninth postoperative day, and finally, in Case I, there was some swelling in the wound due to the cicatrix and reaction to the ribbon-gut. Of the three patients who had purulent drainage, one (XXV) had a tuberculous epididymis removed by delivering the testis through the hernia incision. In all probability, this was the direct cause for the drainage.

There were two patients in whom general complications developed. In Case IV, a transurethral prostatic resection was done. Following the two procedures the patient developed a severe bronchitis and the temperature fluctuated between 97.6° and 104°F., the latter being due to the transurethral operation. In Case XIV, in which a bilateral herniorrhaphy was performed, the patient had four separate pulmonary infarcts, occurring on the ninth, eighteenth, twenty-seventh, and thirty-fourth postoperative days respectively, the last attack terminating fatally. The cause of death was confirmed at autopsy.

The mortality in the series was approximately 4 per cent.

Of the twenty-six cases, twenty-one or 80 per cent have had no recurrence; and two cases (XXV and XXVI) have had the repairs so recently that no check-up has been done. Two recurrences occurred. Case XV had a recurrence eight months after operation with no adequate reason. Case XXI had a large incisional hernia from a previous nephropexy, and a recurrence occurred on the twentieth postoperative day.

CONCLUSIONS

1. A series of twenty-six cases of herniorrhaphy employing ribbon-gut has been reported.

2. There have been two recurrences, one case being a large incisional hernia.

3. This method of repair compares favorably with other methods in general use today.

* The suture material used in this series of cases was D. & G. chromic ribbon-gut, manufactured by Davis & Geck, Inc.

SUMMARY OF CASES OF HERNIA REPAIRED BY RIBBON-GUT METHOD

Initials of Patient	Sex	History No.	Age	Type of Hernia	Type of Operation	Anesthesia	Convalescence	Complications		Result	Remarks
								Local	General		
1. A. F.....	M	22930	2½	Right, incomplete indirect, inguinal	High ligation of sac; Bassini modified technique using 3 ribbon gut sutures from conjoined tendon and internal oblique to edge of Poupart's liagment.	Ether	Uneventful except child cried almost continuously, thereby putting great strain on operative area.	Swelling due to scar tissue, and reaction to ribbon gut.	None	Excellent. No recurrence.	
2. D. H.....	M	99769	24	Right, incomplete, indirect, inguinal.	High ligation of sac; 4 ribbon gut sutures joined the internal oblique and conjoined tendon to edge of Poupart's ligament.	Spinal	Uneventful	Small amount of serum from edge of wound on ninth postoperative day.	None	Excellent	Up on fourteenth postoperative day.
3. F. V.....	M	100259	43	Left, direct, inguinal hernia.	High ligation of sac; abdominal wall repaired with 4 ribbon gut sutures after the Bassini technique.	Spinal	Uneventful	None	None	Excellent	Wound healed per primam
4. L. J.....	M	50623	47	Right, incomplete, indirect, inguinal.	High ligation of sac; abdominal wall repaired with ribbon gut after Bassini technique.	Spinal	Patient had a bronchitis after herniorrhophy. Also vesical neck resection. Rather stormy convalescence.	Six days postoperative 3 oz. pus were evacuated from hernia wound, which drained for one month.	Temperature fluctuated between 97.6° and 104° the first 5 postoperative days.	Good	No recurrence of hernia
5. F. M.....	F	79227	11	Right, incomplete, indirect inguinal.	High ligation of sac; external oblique sutured to shelving edge of Poupart's ligament with ribbon gut. Bassini technique.	Gas-Oxygen	Uneventful	None	None	Excellent	Up on feet eleventh postoperative day. No recurrence.
6. C. C.....	M	82017	39	Bilateral, incomplete, direct, inguinal herniae.	Sacs ligated high; external oblique and lateral border of the rectus sheath sutured to Poupart's ligament with ribbon gut, on each side. Bassini method.	Spinal	Uneventful	None	None	Excellent	Up fourteenth postoperative day. No recurrence
7. W. D.....	M	21779	52	Bilateral, incomplete, indirect, inguinal herniae.	Sacs ligated high; abdominal wall on each side repaired with ribbon gut after Bassini technique.	Spinal	Uneventful	None	None	Excellent	Up seventeenth postoperative day. No recurrence on right. One year later recurrence on left side.
8. P. T.....	M	51226	69	Bilateral, incomplete, indirect, inguinal herniae.	Sacs ligated high; abdominal wall on each side repaired with 4 ribbon-gut sutures after Bassini technique.	Spinal	Uneventful	None	None	Excellent	No recurrence.
9. O. P.....	M	65008	32	Left, incomplete, direct, inguinal hernia.	Sac ligated high; internal oblique to border of rectus; external oblique to border of rectus with ribbon gut sutures to Poupart's ligament. Bassini technique.	Spinal	Uneventful	None	None	Excellent	Up on fourteenth postoperative day. No recurrence.
10. B. W.....	M	68579	64	Bilateral, incomplete, direct, inguinal herniae.	Sacs ligated; conjoinded tendon sutured to Poupart's ligament with 3 ribbon gut sutures on each side. Bassini technique.	Spinal	Uneventful	None	None	Excellent	Up twenty-first postoperative day. No recurrence.
11. B. N.....	M	69876	50	Bilateral, incomplete, indirect, inguinal herniae.	Sacs ligated; abdominal wall on each side repaired with ribbon gut sutures after the Bassini technique.	Spinal	Uneventful	None	None	Excellent	Up on eighteenth postoperative day. No recurrence.
12. S. A.....	M	58883	42	Left, complete, indirect, inguinal hernia.	Sac ligated; abdominal wall repaired with ribbon gut sutures after the Halstead technique.	Spinal	Uneventful	None	None	Excellent	Patient also had a left epididymectomy for tuberculosis. Up on thirteenth postoperative day.

13. T. L.....	M	117278	12	Bilateral, incomplete, indirect herniae.	Sacs ligated; abdominal wall repaired on each side with ribbon gut sutures after the Bassini technique.	Spinal	Uneventful	None	None	Excellent	Patient also had a right orchidopexy performed at the same time. Up on thirteenth postoperative day. No recurrence.
14. G. C.....	M	127385	62	Bilateral, incomplete, indirect, inguinal herniae.	Sacs ligated; abdominal wall repaired on each side with ribbon gut sutures after the Bassini technique.	Spinal	Patient had a pulmonary infarct on ninth postoperative day, another attack on eighteenth P.O. day, another on twenty-seventh P.O. day, and a fourth on the thirty-fourth P.O.	None	4 attacks of pulmonary infarcts, the last one being fatal.	Death	Herniorrhaphies healed nicely, patient died of pulmonary infarct on thirty-fourth postoperative day. Confirmed by autopsy.
15. W. J.....	M	130031	53	Right, incomplete, indirect, inguinal hernia.	Sac ligated high; abdominal wall repaired with ribbon gut sutures after the Bassini technique.	Spinal	Uneventful	Slight amount of purulent secretion from wound.	None	Recurrence 8 months later.	Remained in bed fourteen days. No recurrence at time of discharge.
16. C. E.....	M	131571	24	Right, incomplete, indirect, inguinal hernia.	High ligation of sac; abdominal wall repaired with ribbon gut sutures after the Bassini technique.	Spinal	Uneventful	None	None	Excellent	Up on fourteenth postoperative day. No recurrence.
17. E. L.....	M	154781	37	Left, incomplete, indirect, inguinal hernia.	High ligation of sac; abdominal wall repaired with ribbon gut sutures after the Bassini technique.	Spinal	Uneventful	None	None	Excellent. No recurrence	Patient also had a plastic operation for sexual impotence 5 days prior to the herniorrhaphy. Up on fourteenth postoperative day.
18. F. W.....	M	25822	40	Right, incomplete, indirect, inguinal hernia.	High ligation of sac; appendix removed; abdominal wall repaired with 4 ribbon gut sutures, after the Bassini technique.	Spinal	Uneventful	None	None	Excellent	No recurrence. Up on twenty-first day.
19. B. W.....	M	108399	65	Bilateral, incomplete, indirect, inguinal herniae.	No definite sacs; abdominal wounds repaired after Bassini technique, using ribbon gut.	Spinal	Uneventful	None	None	Excellent	Also had plastic operation for sexual impotence. Up on fourteenth postoperative day.
20. C. J.....	M	108435	19	Right, incomplete, indirect, inguinal hernia.	Appendix removed; high ligation of sac; abdominal wound repaired after Bassini technique, using ribbon gut.	Spinal	Uneventful	None	None	Excellent	Up on fourteenth postoperative day. No recurrence.
21. L. M.....	F	63016	58	Right incisional hernia (previous nephropexy).	Peritoneum closed; fascia and muscle layers closed with interrupted ribbon gut sutures.	Spinal	Uneventful	None	None	Recurrence in one month.	Separation of fascia after discharge from hospital on 20th day.
22. B. J.....	M	105033	48	Bilateral, incomplete, indirect, inguinal herniae.	Sacs ligated high; abdominal wounds repaired after Bassini technique with interrupted ribbon gut sutures.	Spinal	Uneventful	None	None	Excellent. No recurrence	Patient was up on the thirteenth postoperative day.
23. F. H.....	M	99782	43	Left, inguinal, indirect, incomplete hernia.	No definite sac; repair of abdominal wall after Bassini technique with ribbon gut sutures.	Spinal	Uneventful	None	None	Excellent. No recurrence.	Patient up on twenty-first postoperative day.
24. M. C.....	M	42452	63	Bilateral, inguinal hernia (indirect, incomplete).	High ligation of sac; abdominal wall repaired after Bassini technique with 4 ribbon gut sutures.	Spinal	Uneventful	None	None	Excellent	Up on seventeenth postoperative day. Patient operated on recently. Has not been seen since discharge from hospital.
25. S. A.....	M	58883	47	Right, incomplete, indirect, inguinal hernia.	High ligation of sac; abdominal wall repaired after Bassini technique with ribbon gut sutures.	Spinal	Uneventful	Purulent drainage from wound.	None	Improved	Patient had a tuberculous epididymis removed thru hernia incision. Patient up on seventeenth day. Case operated on recently.
26. B. E.....	M	166471	44	Bilateral incomplete, inguinal herniae.	No definite sacs found. Abdominal wall repaired after Bassini technique with ribbon gut.	Spinal	Uneventful	None	None	Excellent	Patient up on fourteenth postoperative day. Recently operated on—no check-up yet.

MALIGNANT FATTY TUMORS OF THE RETROPERITONEAL REGION*

REPORT OF TWO CASES

CHARLES W. McLAUGHLIN, JR., M.D. AND JOHN C. SHARPE, M.D.

Instructor in Surgery, University of Nebraska College of Medicine

Instructor in Internal Medicine, University of Nebraska College of Medicine

OMAHA, NEBRASKA

MALIGNANT tumors of the retroperitoneal region have always presented interesting diagnostic and therapeutic problems. In spite of the many advances in the technique of clinical and Roentgen localization, errors in the diagnosis of such neoplasms continue to be frequent.

Recently, we have observed two unusual cases of malignant retroperitoneal tumor arising in the fatty tissue. The relative infrequency of this type of tumor justifies their being reported.

CASE REPORTS

CASE 1. Mrs. C. F., a 55 year old white housewife, entered the University Hospital January 2, 1933 in a semicomatose condition. the family related that the patient's abdomen had grown progressively larger over a period of ten years. A diagnosis of a large ovarian cyst had previously been made, but operation was refused by the patient. Apparently she had suffered no untoward abdominal complaints until three weeks prior to admission to the hospital. At that time, generalized body aches and pains developed, associated with cough, some difficulty in urination, and mental dullness. The patient had been semicomatose for twenty-four hours before admission.

On examination, she was found to be extremely emaciated with a tremendously enlarged abdomen. The temperature was 97 degrees, the pulse 100. There was nothing remarkable about the eyes, nose or throat. Except for bilateral elevation of the diaphragm and lateral displacement of the heart, there was no evidence of any existent cardiorespiratory disease. The veins of the abdominal wall were visibly enlarged. A large, irregular, hard mass was palpable in the lower left quadrant of the abdomen, which extended upward and across the epigastrium. A moderate amount of free fluid was thought to be present in the peritoneal cavity. There was some edema of the lower extremities.

Laboratory examinations included a blood count showing a hemoglobin of 40 per cent, erythrocytes, 3,280,000, and leucocytes 21,300, of which 96 per cent were of the polymorphonuclear type. During her ten-hour period of hospitalization, a urine specimen could not be obtained. The blood non-protein nitrogen was 148 mg. per cent, and the creatinine 7.62 mg. per cent.

A diagnosis was made of a large intra-abdominal, solid tumor mass, probably malignant, the pressure of which caused the ascites, edema and urinary obstruction. An abdominal paracentesis was attempted, but only a small amount of clear fluid was obtained. The patient died on the night of admission.

Post-mortem Examination (Dr. P. Tollman). On opening the abdomen there were 1 or 2 liters of clear straw-colored fluid present. A roughly spherical mass occupied the entire lower abdominal cavity, filling the pelvis and extending upward above the level of the costal margin. This mass was attached to the abdominal wall above the level of the umbilicus, but not below. The small bowel was displaced above the mass, which was pressing against the dome of the diaphragm at the level of the second interspace on the right and the third rib on the left. Considerable sharp dissection was necessary to free the mass from the posterior wall of the pelvis and along the lumbar spine.

The tumor, after removal of the kidneys and uterus, weighed 56 pounds (25.45 Kg.). The uterus and bladder were attached firmly to the anterior surface, with some infiltration

* From the Departments of Surgery and Medicine, University of Nebraska College of Medicine, Omaha.

of their walls. The uterus had been drawn upward until its fundus lay 15 cm. above the symphysis pubis. Both tubes and ovaries were free in front of the mass and were not involved by the tumor. The ureters had been surrounded, leading to dilatation of these and the kidney pelves. The right kidney remained as a thin-walled sac with a few buttons of kidney tissue in the wall. The pelvis of the left kidney was greatly dilated, but a moderate amount of kidney tissue remained. No distant metastases were found at autopsy.

Section through the mass revealed a cavity along its left border containing about 4,000 c.c. of reddish puriform material. The wall of this septic cavity was ragged and semi-necrotic as a result of degeneration in the tumor mass. The remainder of the tissue varied from yellow to white in color and was moderately firm in consistency. In many areas the tissue presented a mucoid or gelatinous appearance. Small masses of rather typical appearing fat, varying in size from 1 mm. to 3 cm. in diameter, were dispersed through the tumor.

Microscopic Examination. The tissue was composed of spindle- and stellate-shaped cells of rather small size with considerable amounts of intercellular material. This was finely fibrillary or mucoid in character. Fat stains showed fine globules of fat in many cells and differentiation of these cells to the adult type of fat cell was seen in several sections.

The pathologic diagnosis was lipomyxosarcoma of the retroperitoneal tissues arising at the pelvic brim.

Case II. Mrs. N. S., a 44 year old, white, married female, first entered the University Hospital, June 29, 1922, for a normal delivery of her eighth child. Six months later, she was readmitted to the hospital for a perineorrhaphy. At that time, her weight was 175 pounds. A left indirect inguinal hernia was found, but no palpable abdominal mass was noted.

The patient reëntered the hospital for the third time thirteen years later, at the age of 58 years, with a two-year history of upper left quadrant and epigastric distress. This was first noted following a fall with injury of the lower left chest. The pain was of a constant, dull, aching character, following along the left costal border, and was not related to meals. Seven months before entrance, she had first noted the appearance of a mass in the upper left abdomen which had become progressively larger. Recently, she had suffered from attacks of nausea (without vomiting), anorexia, and the loss of 40 pounds in weight.

The physical examination disclosed a well developed, somewhat obese woman of 164 pounds. The temperature was 100.2 degrees, pulse 92, and blood pressure 148 systolic and 104 diastolic. The following positive points were noted in the examination: slight nonpitting edema of the hands and feet; a moderate arteriosclerosis of the peripheral vessels; and a slight cardiac enlargement without evidence of valvular deformity. Examination of the abdomen revealed a large, smooth, hard, painless mass in the upper left quadrant which extended downward to the crest of the ileum and which was thought to be spleen. A second hard nodular mass was felt in the epigastrium extending down to the umbilicus. The liver was not enlarged, and there was no generalized lymphadenopathy. The pelvic examination was negative.

The complete blood, differential, reticulocyte and platelet counts were normal, as well as the hematocrit determinations, the bleeding and clotting time, the erythrocytic fragility test, and the sedimentation rate. The urinalysis, Wassermann, Takata Ara test, and agglutination for Brucella melintensis were all negative. The icterus index, blood sugar, and a glucose tolerance test were found within normal limits. There was a moderate hypochlorhydria of the gastric contents; the stool was negative for occult blood. Roentgenograms of the gastrointestinal tract revealed the abdominal mass to be pushing the stomach to the right and the transverse colon, splenic flexure and descending colon downward. The mass was interpreted as a splenic tumor. Intravenous pyelograms failed to show any gross displacement of the left kidney.

A preoperative diagnosis of a retroperitoneal sarcoma and splenomegaly was made, and surgical exploration of the abdomen advised. We did not feel that the splenomegaly was either hematologic, traumatic or infectious in origin.

Operative Note. Under spinal anesthesia the abdomen was opened through a left rectus incision. A large tumor mass arising retroperitoneally in the region of the left kidney was found. The mass extended up under the left costal margin, down to the crest of the ileum and across the spinal column medially. The spleen was normal in size, being displaced upward and anteriorly. The small intestine was

pushed well to the right side of the abdomen. The omentum was plastered to the mass on its inferior surface.

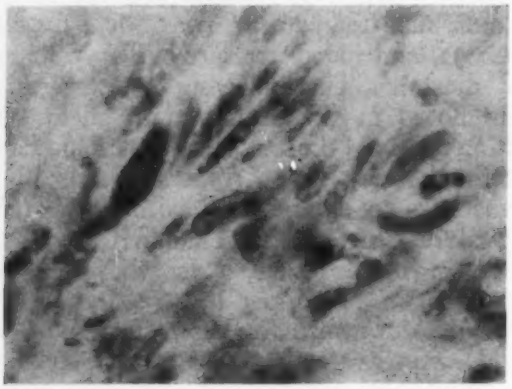


Fig. 1. Photomicrograph of tissue removed at operation in Case I. Fat globules are seen dispersed through many of the cells.

In several areas the mass felt cystic to palpation, but aspiration with a large explorating needle was unsuccessful.

The transverse colon was retracted upward and the posterior peritoneum was opened, exposing the mass. Two large pieces of firm yellowish-white tissue were freed by blunt dissection and removed. The size of the tumor and its firm posterior attachment made complete enucleation impossible. The abdomen was colored in layers and the patient returned to her bed in fair condition.

The pathologic report was lipomyxosarcoma of the retroperitoneal region arising in the region of the left kidney.

Surgical Specimen. Gross. There were several masses of tumor that looked very much like adipose tissue. The largest mass was 11 by 8 cm. and was fairly well encapsulated. Around the periphery there were numerous small areas of more dense compact tissue, light yellow or white in color. Towards the center the tissue had more the color and consistency of mucus. Two of the smaller masses had a rather firm capsule with a grayish mucus mass inside the capsule. All the tissue removed weighed 850 Gm.

Microscopic. There were a number of sections, some consisting of normal fat, and other sections taken from the tumor proper. (Fig. 1.) The cells of the tumor mass were generally of a blunt spindle shape and most of the nuclei were vesicular in character. In other areas the cells were more elongated, showed a fibrillary structure and were arranged in loosely interwoven strands. There was very extensive necrosis in a number of areas. Fat stains were made from several locations and these showed that the majority of cells contained small globules of fat of varying size. In the more necrotic areas, the fat was frequently collected in rather large globules.

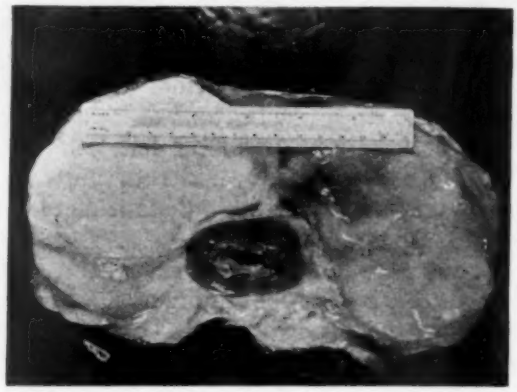


Fig. 2. Tumor mass removed at post-mortem from Case II. This specimen demonstrates the complete encapsulation of the left kidney without invasion of its substance by the new growth.

Postoperative Course. During the second postoperative day, the patient developed signs of beginning myocardial insufficiency, but with digitalis and morphine, they promptly disappeared. On the twelfth day and continuing to the limit of tolerance for thirty-four days, deep *x*-ray therapy was administered (1600 R) through the anterior and posterior parts of the upper left abdomen. In spite of the heavy radiation, the remaining abdominal tumor-mass slowly increased in size. At the time of dismissal, on the sixty-fifth hospital day, the mass measured 18 cm. transversely and was down to 5 cm. below the level of the umbilicus.

The patient was readmitted to the hospital in a moribund condition two months later for the fourth and last time. For six weeks, there had been a slowly progressive edema of the lower extremities, followed shortly by an increase in the size of the abdomen. Weakness and numbness of the legs had developed and a severe girdle type of pain was present in and about the lower costal margins. The mass was found to have increased greatly in size, filling the entire upper left abdomen. The patient died five days after admission.

Post-Mortem Examination (Dr. P. Tollman). A retroperitoneal mass in the left upper quadrant of the abdomen displaced the transverse

colon and the splenic flexure downward. The duodenum was pressed to the right, so that the duodenojejunal junction was 4 cm. to the

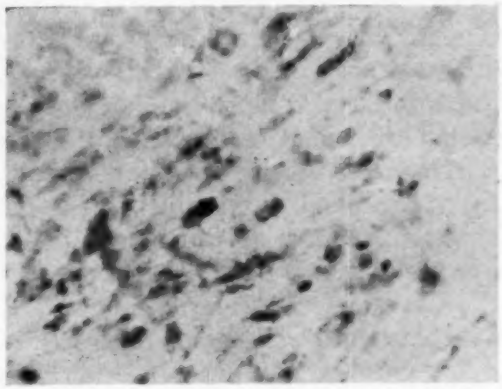


Fig. 3. Photomicrograph of tissue removed at post-mortem from Case 11. The character of the cells with the fine fibrillary intracellular material is demonstrated. Occasional mitotic figures are seen.

right of the midline. Loops of small bowel were adherent to the medial surface of the tumor, but none were incorporated in the mass. The spleen was small and was pressed against the left leaf of the diaphragm. The pancreas lay across the anterior surface of the mass, but was not invaded by it.

The cut surface showed considerable variation, being composed of roughly spherical masses of firm fibrous tissue merging into loose areolar areas. The color varied from light yellow to nearly white, and in places the cut surface presented a glistening mucoid appearance. The left kidney and left adrenal were almost completely surrounded, but had not been invaded by the tumor tissue. (Fig. 2.) No distant metastases were present. The tumor on removal weighed 12 pounds.

Microscopically the tissue was composed of spindle to stellate cells with a varying amount of intercellular, finely fibrillary material. Fat stains showed minute globules of fat in very many of the cells, particularly in the light yellow areas. Nuclei were generally centrally placed, with chromatin arranged in fine granules. Occasional mitotic figures were found in some areas. (Fig. 3.)

DISCUSSION

Benign Retroperitoneal Lipomata. There are many recent reports in the literature of large benign retroperitoneal lipomata.[1,2,3,4,5,6] These tumors appear to be slightly more common in the female, and are usually seen in patients between the ages of 40 and 60 years. Mayo and Dixon[1] found that 80 per cent of these simple retroperitoneal lipomata arose in the abdomen and 20 per cent in the pelvis. The most common site of origin is in the perirenal fat, but they may arise in the renal capsule, mesentery, pararectal or retrorectal fat.

The presenting symptom is usually progressive enlargement of the abdomen unassociated with pain. Moderate loss of weight is usually observed and ascites is sometimes present. Examination discloses a palpable mass, ovoid in shape and fixed posteriorly. The surface is usually quite irregular. The mass is firm in consistency, but this may vary in different portions of the tumor.

Accurate diagnosis of the exact type of tumor has rarely been made until exploration has been undertaken. Many of these large benign retroperitoneal lipomata, some of them of tremendous size, have been successfully removed. Recurrence following surgical removal is not infrequent and there is a definite tendency for these long-standing lipomata to undergo malignant change.[7,8,9]

Malignant Retroperitoneal Lipomata. In 1857, Virchow reported the first microscopic studies on a malignant tumor of fatty tissue. Robertson[10] reviewed the literature in 1916 and was able to collect fifty-one such cases, one-third of which arose in the retroperitoneal tissues and the remaining two-thirds in the upper and lower extremities. Von Wahlendorf[11] subsequently published a critical review of 168 cases of malignant fatty tumor. Since his report, additional isolated cases have been reported. In Mayo and Dixon's series,[1] 54 per cent of the retroperitoneal fatty tumors were pure lipomas, 46 per cent were mixed in type, and 14 per cent showed definite sarcomatous change.

Many theories of origin have been suggested for these retroperitoneal fatty tumors, but the etiology remains obscure.

Haagensen and Krebheil[13] recently reported the production of liposarcoma in experimental animals following the injection of benzopyrene. From their experimental results, these authors believe that liposarcoma arises in adult fat cells as a result of long-standing chemical irritation and stimulation.

These malignant fatty tumors vary greatly in size, the largest reported weighing 60 pounds. Grossly, the mass is usually lobulated, gray or yellowish white in color, with localized areas appearing brown or red. On section, the surface is often glistening due to the myxomatous tissue present. Caldwell and Zinninger[14] describe three types of malignant fatty tumor tissue identified on histologic section.

1. *Lipomyxosarcoma.* The lipomyxosarcoma appears to be much the most common form of malignant fatty tumor, and it was the type found in our two cases. These tumors usually arise in the retroperitoneal tissues or in the intermuscular septa of the extremities. They are locally malignant, grow by extension, and have a strong tendency to recur if incompletely removed. Metastasis from this type of tumor is infrequent. Histologically, three types of tissue can be found: (a) adult fat cells, (b) embryonic stellate fibroblasts, and (c) gelatinous semifluid material simulating mucin.

2. *Lipomata with Areas of Sarcomatous Degeneration.* Since the sarcoma arises from the fibrous connective tissue and retains the characteristics of a true fibrosarcoma, Caldwell and Zinninger[14] do not consider the lipoma with scattered areas of sarcomatous change a true malignant tumor of fatty tissue.

3. *True Liposarcoma.* The true liposarcoma is extremely rare. It is probably a tumor of embryonal fat cells characterized by a definite tendency to invade the adjacent tissue and to produce distant metastasis. Such a tumor, recurring in the thigh after excision, has been reported by Jones and McClintock.[15] Lifvendahl[16] observed a patient with bilateral primary liposarcoma of the breast with extensive pulmonary metastasis. Primary liposarcomata of bone have been reported by Stewart,[17] Rehback and Houser,[18] Fender,[19] and Barnard.[20] Pulmonary and cranial metastases are common with this type of malignant fatty tumor. Four of the seven reported cases of true primary liposarcoma of bone showed terminal cranial metastasis.

From a clinical standpoint, it is impossible to make an accurate preoperative diagnosis of the type of fatty tumor present. Certain characteristics, however, should lead one to suspect the possibility of a malignant rather than benign lipoma. Though cases are seen in both the young and the aged, the patients are usually in mid-life and of the female sex. The chief presenting complaint is usually that of abdominal fulness associated with a history of a mass slowly growing over a period of many months or years. Pain and symptoms of obstruction are usually absent. While the patients may give the general impression of having lost weight, not infrequently the actual weight remains constant or increases due to the enlarging bulk of tumor tissue.

Examination discloses the presence of an abdominal tumor, appearing slightly more often on the left side. Occasionally the patient may have been unaware of its presence until routine examination discloses it. The tumor is outlined as an irregular, abdominal mass of variable size, firm in some areas and doughy, semi-fluctuant, or cystic in others. The mobility of the mass is usually limited by its posterior attachment. As in Case 1, the entire abdomen may become distended with the tumor.

The lesions most apt to be confused in the differential diagnosis are splenomegaly, tumors of the spleen, hypernephroma, ovarian cysts and abdominal carcinomatosis. Careful Roentgen studies of the gastrointestinal and genitourinary tracts, together with the possible employment of a pneumoperitoneum or a retroperitoneal air injection will assist in accurately localizing

the new growth. Films of the skull and chest should be taken in all suspected cases to exclude the possibility of pulmonary or cranial metastasis. In the preoperative study of such patients, it is extremely important that one carefully investigate the renal function on both sides. Not infrequently, these tumors so completely surround one kidney and its pelvic structures that to permit removal of the mass at operation, a nephrectomy is necessary. This was done in 50 per cent of the reported cases.

Surgical exploration should be undertaken in all cases in which the general condition of the patient permits. Because of the large size these tumors attain, the transperitoneal approach, if technically possible, is the method of choice. They are usually fairly well encapsulated and complete enucleation is often possible. The major difficulty generally arises in freeing the tumor from the region of the mesenteric vessels. In addition, the multilobular character of the growth may make it extremely difficult to remove all the small projections, and these, if left, may grow and produce massive recurrences. Cases have been reported in which large masses of malignant tissue have been removed on successive occasions over a period of years before a fatal result ensued. In such instances, the tendency is for the tumor to become increasingly malignant with each operative attack.

The use of deep radiation therapy has been advised, both alone and in conjunction with surgical excision. Though Stewart[17] reports definite benefit from radiation in the treatment of true liposarcoma of bone, Rehback and Houser[18] and Barnard[20] observed little or no improvement. In the lipomyxosarcoma type of tumor, Selman[21] treated his case with radiation therapy in conjunction with surgery. In spite of a later recurrence, he felt that the radiation definitely retarded the growth of the tumor. On the other hand, Williams[7] and Seids and McGinnis[12] were unable to observe any beneficial effect from the radiation of their patients, and this, also, was our experience with Case 11. From the microscopic examination of the tissues in our two cases, one would expect very little from radiation therapy.

SUMMARY

1. Two cases of large lipomyxosarcoma of the retroperitoneal region are reported.

2. These retroperitoneal tumors are relatively infrequent but not rare.

3. The pathology and clinical features have been briefly reviewed. Of special importance is the chronicity of symptoms, and the relative slight loss of weight, as compared to patients with other types of neoplastic disease.

4. Attention is directed toward the importance of determining renal function preoperatively, as in many instances nephrectomy is necessary at the time of operation to insure complete removal of the tumor.

5. Complete surgical removal seems the only method of treatment. In our experience, postoperative radiation therapy apparently had no beneficial effect in the treatment of malignant fatty tumors in the retroperitoneal region.

REFERENCES

1. Mayo, C. H., and Dixon, C. F. Retroperitoneal lipoma—report of three cases. *Minnesota Med.*, 10: 272, 1927.
2. Masson, J. C., and Horgon, E. J. Retroperitoneal lipomas. Report of 12 cases. *S. Clin. North America*, 11: 105, 1931.
3. Andrews, E. Enormous retroperitoneal lipoma. *S. Clin. North America*, 11: 105, 1931.
4. Greensfelder, L. A., and Bettman, R. B. Retroperitoneal lipoma. *Surg., Gynec. & Obst.*, 37: 468, 1923.
5. Bettman, R. B., and Serby, J. Retroperitoneal lipoma. *Arch. Surg.*, 24: 300, 1932.
6. Burger, T. O. Large retroperitoneal tumor. *S. Clin. North America*, 7: 1285, 1927.
7. Williams, C. Retroperitoneal lipomyxosarcoma. *J. A. M. A.*, 105: 195, 1935.
8. Schiller, H. Lipomata in sarcomatous transformation. *Surg., Gynec. & Obst.*, 27: 218, 1928.
9. McConnell, G. Recurrent liposarcoma of the kidney. *J. Med. Research*, 19: 225, 1908.
10. Robertson, H. E. Lipoma myxomatodes. *J. Med. Research*, 35: 131, 1916.

11. Von Wahlendorf. Quoted by Seids and McGinnis.
12. Seids, J. V. and McGinnis, R. S. Malignant tumors of the Fatty Tissue. *Surg., Gynec. & Obst.*, 44: 232, 1927.
13. Haagensen, D. C., and Krebhiel, O. F. Liposarcoma produced by 1:2 benzopyrene. *Am. J. Cancer*, 27: 474, 1936.
14. Caldwell, J. A., and Zinninger, M. M. Epidural liposarcoma of the spinal canal. *Surg., Gynec. & Obst.*, 40: 476, 1925.
15. Jones, T. E., and McClintock, J. C. Liposarcoma. *Ann. Surg.*, 98: 470, 1933.
16. Lifvendahl, R. A. Liposarcoma of the mammary gland. *Surg., Gynec. & Obst.*, 50: 81, 1930.
17. Stewart, F. W. Primary liposarcoma of bone. *Am. J. Patb.*, 7: 87, 1931.
18. Rehback, D. J., and Houser, H. Liposarcoma of bone. *Am. J. Cancer*, 27: 37, 1936.
19. Fender, F. A. Liposarcoma—report of a case with intracranial metastasis. *Am. J. Patb.*, 9: 909, 1933.
20. Barnard, L. Primary liposarcoma of bone. *Arch. Surg.*, 29: 560, 1934.
21. Selman, W. A. Report of a case of lipoxyxosarcoma. *Internat. Clin.*, 1: 136, 1931.

The first postmortem examination conducted by white men in North America . . . was performed on July 18, 1533, in the town of Santo Domingo on the island of Español [Haiti and Santo Domingo]. Female "Siamese twins" had died after eight full days of life. The purpose of the examination was to determine whether there were two souls or one, a matter of grave concern to the officiating clergyman. Master-surgeon Johan Camacho performed the examination, solved the spiritual problem and ignored the cause of death.

From—"The Postmortem Examination" by Sidney Farber (Thomas).

CAPILLARY AND CAVERNOUS HEMANGIOMA OF THE SPLEEN (TELANGIOMA)

REPORT OF A CASE

ILHAMI AKCAKOYUNLU, M.D.

Surgeon-in-Chief, Model Hospital

DIYARBEKIR, TURKEY

PRIMARY vascular tumors of the spleen have been known by many names such as angioma, hemangioma and telangioma, but in origin and pathology, one may say that all are the same. To date, there have probably been thirty cases reported as splenic angiomata. However, it is rather difficult to accept all of them as true hemangiomas. According to Matas, who described and identified them very clearly, angiomas do not metastasize or spread to adjoining organs and their behavior is essentially that of benign neoplasms, whereas several published cases have shown a malignant character.

In searching the literature and analyzing these cases from the foregoing standpoint, we have arranged a table (Table 1) comparable to Dowd's, published in 1915, with the exception that some cases have been excluded and others more recent added. Among the cases excluded, are those reported by Langhans, Homans, Jores, Ernst, Theile and Dowd. These six cases are considered malignant because of the involvement of other organs. We have added a case described in 1895 by Hoge as an angioma of the spleen, and also cases reported from 1915 to the present time, thereby enlarging the table. This is a total of twenty-one hemangiomas of the spleen which I am willing to accept. Six of the twenty-one cases were reported from autopsies; in one of the fifteen operated cases there was an emergency due to rupture of the angiomatous spleen. The remaining fourteen angiomas were found at operation.

CASE REPORT

A. N., male, aged thirty years, was admitted to the surgical clinic on March 3, 1935, complaining of increased enlargement of the abdomen, dyspnea and difficulty in walking. The past history was not remarkable except for an illness three years previous in which the patient had high fever for ten days. After this disease of unknown etiology he noticed a small lump in the left upper hypochondriac region of the abdomen. In time, the tumor gradually increased until it occupied almost the whole abdomen.

The patient was married, had children and had no history of familial disease.

Physical examination disclosed a well developed and muscular man. He had no fever, icterus, other skin changes, enlarged lymph nodes or edema. The abdomen was markedly distended. Palpation revealed a large mass occupying the whole of the left and part of the right hypochondrium and extending to a few centimeters above the pubis. It moved slightly with respiration and was thought to be the spleen. The liver did not appear to be enlarged. The cardiovascular and other systems were normal. The blood examination was as follows: erythrocytes, 5,270,000; hemoglobin 65 per cent; white blood cells 7,100 with neutrophiles 70 per cent, large mononuclears 5 per cent, lymphocytes 23 per cent and eosinophiles 2 per cent. The clotting time was normal. The Wassermann test was negative.

Operation (March 9, 1935). Under general anesthesia the abdomen was opened through a midline incision starting above the umbilicus and extending to 5 cm. above the pubis. When the peritoneum was opened an enormous spleen appeared, dark blue in color and with enlarged veins on the surface. The spleen was adherent to the anterior abdominal wall, omentum and transverse colon, and separation of the adhesions was accomplished with difficulty. The pedicle, which was very thick, was tied and the spleen was removed. No enlarged lymph nodes were found. The liver and other abdominal organs were normal.

TABLE I

TABULATION OF CASES OF HEMANGIOMA OF THE SPLEEN

Case No.	Author	Journal	Sex	Age	Duration	Symptoms	Operation	Result	Pathology
1	Hoge, Jr.	Med. Rec., 48: 918, 1895.	F.	45	4 years	Loss of weight, alternating constipation and diarrhea, swelling of left side abdomen, no pain.	Splenectomy	Cured	Spleen: 8 × 5 × 1¾ inches. Splenic stricture disappeared, large cavernous openings. Diagnosis: angioma cavernosum of spleen.
2	Martin and Ombrédanne	Bull. et mém. Soc. anat., 79: 59, 1904; Rev. de gynec. et de chir. 1909, p. 67.	F.	31	Some months	Pain in left hypochondrium, loss of weight, constipation, tumor felt supposed to be in spleen.	Splenectomy	Cured	Spleen: Surface studded with violet-gray spots. Gross section showed spongy, compact and intermediate areas, spongy cavernous mixture of malpighian corpuscles and pulp. Trabeculae of dense connective tissue. Microscopically, compact: slight connective tissue thickening, collections of red corpuscles. Intermediate: venous sinuses enlarged. Central artery sclerotic. Lesion characterized by transition of splenic substance to cavernous, filled with clots. Diagnosis: angioma of spleen.
3	Albrecht	Ztschr. f. Heilk., 3: 97, 1902.	M.	65	.....	Autopsy report.	.....	.....	Spleen: Much enlarged, normal shape. About six cavernous knots, bean and pea-sized. Contained blood, hyperplasia of pulp cells. Radiating fissures connecting arteries, blood spaces, caverns and veins. Malpighian corpuscles around cavernous blood spaces.
4	Theile	Virch. Arch., 178: 296.	M.	22	.....	Autopsy report by Lubarsh, No. 77, 1900.	.....	.....	Spleen: Slightly enlarged, soft cherry-sized spots, tumor sharply marked off, numerous capillaries in periphery, endothelium swollen, contained blood and thrombus. Spindle cells between blood spaces. Center cavernous, contained thrombus. Diagnosis: obliterating angioma.
5	Theile	Virch. Arch., 178: 296.	M.	36	.....	Autopsy report by Lubarsh, s. 123, 1901.	.....	.....	Spleen: Enlarged 14 × 7 × 3 cm. Two firm reddish tumors, cherry-sized; at lower pole, larger, similar to preceding case; other composed of large and small freely anastomosing blood spaces, mostly capillaries. Some veins contained thrombus. Diagnosis: obliterating angioma.
6	Theile	Virch. Arch., 178: 296.	M.	62	.....	Autopsy report by Lubarsh.	.....	.....	Spleen: Normal size. Greenish protuberances on surface. Firm dark red protuberance at upper pole, bean-sized. Smaller knot inside spleen. Several knots at lower pole. Tumors had same appearance as in preceding cases but richer in thrombus and spindle-cells. Diagnosis: obliterating angioma.
7	v. Benkendroff	Virch. Arch., 194: 500.	M.	53	2 years	Abdominal swelling. Tumor felt.	Splenectomy	Not reported	Spleen: Large cavernous area replacing three-fourths of normal tissue, sharply marked off from normal tissue. Venous capillaries enlarged, lengthened and walls thinned. Pulp between capillaries compressed and contains follicles, and trabeculae. Cavern contains lymphocytes, pulp cells, red blood cells and colloidal substance.

TABLE I (*Continued*)

Case No.	Author	Journal	Sex	Age	Duration	Symptoms	Operation	Result	Pathology
8	Angilotti	Lo spermantale, archivo di biologia, Supp, 67: 161, 1913.	F.	38	14 months	Severe epigastric pains not related to meals, often terminating in vomiting. Blood examination: R.B.C. 4,580,000; W.B.C. 4,700; hemog. 100 per cent; few platelets. Urine negative.	Splenectomy	Cured	Spleen: Weight 1 kg. Several elevations on surface size of walnut, cyanotic color. In part cyst-like communicating structures lined with endothelium. Elastic fibers present. Filled with fluid, blood clots, fibrin or hyalin masses. Blood spaces dilated, pulp atrophic, other localities showed transition into lymph tracts. Gross section showed numerous angiomata giving cavernous structure. Malpighian corpuscles altered, trabeculae thickened.
9	Müller	Virch. Arch., 238: 76, 1922.	M.	30	.....	Autopsy report.	.....	.....	Spleen: Weight 260 Gm., size 14 × 13 × 4 cm.; 33 nodules of capillary angiomata, composed of capillary lumens, filled with erythrocytes, many enlarged veins.
10	Steden	Arch. f. klin. Chir., 130: 616, 1924.	M.	42	8 years	Swelling left hypochondrium, discomfort in epigastrium. Blood examination: R.B.C. 4,110,000; W.B.C. 8,200; polys 69 per cent; lymph, 30 per cent; mono. 1 per cent. Wassermann negative.	Splenectomy	Cured	Spleen: Measured 26 × 21 × 14 cm. Weight 4125 Gm. Capsule thick, several lumens with endothelial lining, contain blood. Large lumen filled with fibrin, cavernous angioma with many hemorrhages and thromboses.
11	Näher	Deutsch. Arch. f. Chir., 191: 87, 1925.	F.	42	5 years	Enlargement of the abdomen. Blood examination normal.	Splenectomy	Died 30 days later	Spleen: 15 × 10 × 8 cm.; weight 2500 Gm. Composed mainly of a tumor that on section was found strewn with small and large vessel lumina, large blood sinus covered with endothelium, some thrombus.
12	Orlandi	Virch. Arch., 269: 152, 1928.	F.	44	One year	Fatigue, sometimes edema on the inferior extremities. Erythrocytes 4,200,000; large lymph. 5 per cent; small lymph. 48 per cent; transitionals 2 per cent.	Splenectomy	Died 3 hours later from internal hemorrhages.	Spleen: Measured 24 × 10 × 8 cm. Weighed 800 Gm. Capsule thick, composed venous sinuses, vessels mainly net, lumina covered with endothelium, long, ellipsoid spindle-cells, nucleolus very prominent in cells lining lumen, endothelial proliferation, some mitoses. Hemosiderin pigments, cavernous angioma.
13	Schwarz	Beitr. z. klin. Chir., 150: 130, 1930.	F.	35	4 months	Pain and swelling on the left upper quadrant of the abdomen. Blood examination normal.	Splenectomy	Cured	Spleen: Measured 24 × 18 × 10 cm. Weighed 3,500 Gm. Capsule thick, the cut surface bloody and spongy. Many small caverns covered with endothelial cells, in center large cavernous spaces. Some hyalin masses, thick trabeculation.
14	Zeno and Cid	Ann. d'anat. path., 7: 583, 1930.	M.	30	5 months	Loss of weight, fatigue, tumor felt in abdomen. Blood examination: R.B.C. 4,080,000; W.B.C. 1100; polys 38 per cent; lymph. 60 per cent; mono. 1 per cent; transitionals 1 per cent.	Splenectomy	Cured	Spleen: Measured 35 × 25 × 12 cm. and weighed 5,800 Gm. Smooth, capsule thick. On section large blood sinuses, separated by connective tissue trabeculae. In some areas the lumens were filled by proliferating endothelium. Hemangioendothelioma of the spleen.

TABLE I (*Continued*)

Case No.	Author	Journal	Sex	Age	Duration	Symptoms	Operation	Result	Pathology
15	Wassiljeff and Pratasse-witch	Virch. Arch., 279: 79, 1930.	M.	32	One month	Swelling left hypochondrium. Blood examination: R.B.C. 3,700,000; W.B.C. 8,000; neut. 62 per cent; large lymph. 6 per cent; small lymph. 25 per cent; transitionals 5 per cent; eos. 1 per cent.	Splenectomy	Cured	Spleen: Measured 35 × 16 × 10 cm. and weighed 2,900 Gm. Capsule thick. On section many thin-walled angiomatous spaces Capillary dilatation and hyperplastic endothelial pulps.
16	Kellert	Am. J. Cancer, 16: 412, 1932.	F.	52	Long time (?)	Increasing enlargement of the abdomen, malaise, chill, fever. Enlarged spleen extending to the midline and pelvis. Blood examination: R.B.C. 3,482,000; W.B.C. 7,300; hemo. 35 per cent; polys 59 per cent; lymph. 39 per cent; bas. 1 per cent; endothelials 1 per cent.	Splenectomy	Cured	Spleen: Measured 36 × 20 × 8 cm. and weighed 7,700 Gm. Capsule slate-blue color and innumerable petechiae. On section dark red, vascular spaces varied greatly; near the center was a large abscess. Under microscope small and large thin-walled vascular spaces almost completely replaced the normal splenic tissue. Numerous small and large vascular spaces simulating cavernous hemangioma. Spaces were filled with red blood cells and various leucocytes.
17	Plavecino, Villegas and Palazon	Semana Medica V. 2, P. 82 1932.	M.	41	20 years	Swelling left side of the abdomen. Blood examination normal.	Splenectomy	Cured	Angiomatosis of the spleen.
18	Hains and McIlray	J. A. M. A. V. 100, P. 1862, June 10, 1933.	F.	43	?	Sudden pain in epigastrium, nausea and vomiting, abdomen slightly distended.	Splenectomy	Died 48 hours after operation	Spleen: Measured 10 × 5 × 4 cm. Capsule wrinkled on the upper pole, cyst-like spaces containing blood. Under microscope: Circumscribed spaces surrounded by fibrocellular connective tissue. Diagnosis: Spontaneous rupture of cavernous angioma.
19	Mikami	Keijo. jour. of Med. V. 4, P. 53, 1933.	F.	45	.....	Autopsy report.	.....	.....	Spleen: Measured 12 × 7 × 2 cm. and weighed 160 Gm. Capsule thick, 12 small caverns covered with endothelium, separated by homogenous trabeculations. Some lymphangiectatic parts. Multiple cavernous angioma.
20	Grove	Ann. Surg. V. 105, P. 969, June 1937.	F.	4 mo.	Congenital	Vomiting, constipation and restlessness. Lump in left side of abdomen. Blood examination: R.B.C. 3,160,000; hemo. 55 per cent; W.B.C. 17,000; neut. 64 per cent; lymph. 35 per cent; other 1 per cent. Wassermann negative.	Splenectomy	Cured	Spleen: 70.5 Gm. Semi-resistant tumor, separated from the splenic tissue by a thin capsule. Microscopic examination: Tumor consisted of proliferating fibroblastic cells, vessels very numerous and large, vascular space with a thin endothelial lining. Diagnosis: fibro-angioma.
21	Akcakoyunlu	.....	M.	30	3 years	Increasing enlargement of abdomen, dyspenea, large mass occupying whole abdomen, thought to be spleen. Blood examination: R.B.C. 5,270,000; W.B.C. 7,100; neut. 70 per cent; large mono. 5 per cent; lymph. 23 per cent; eos. 2 per cent. Wassermann negative.	Splenectomy	Cured	Spleen: Measured 36 × 26 × 12 cm. and weighed 7,240 Gm. Capsule dark blue color and thick, on cut section numerous small cavities but no large ones. Microscopic examination: Pulp for the most part replaced by a vascular tumor, of capillaries and cavernous spaces, filled with erythrocytes and fibrin. Diagnosis: Capillary and cavernous hemangioma (telangioma).

The postoperative course was uneventful and the patient was discharged in good condition on March 19, 1935. Eighteen months after operation he was in perfect health.

Microscopic Patbology. The splenic pulp was for the most part replaced by a vascular tumor which consisted of capillaries and cavernous spaces filled with erythrocytes and fibrin. The splenic tissue proper was fibrous and devoid of malpighian bodies.

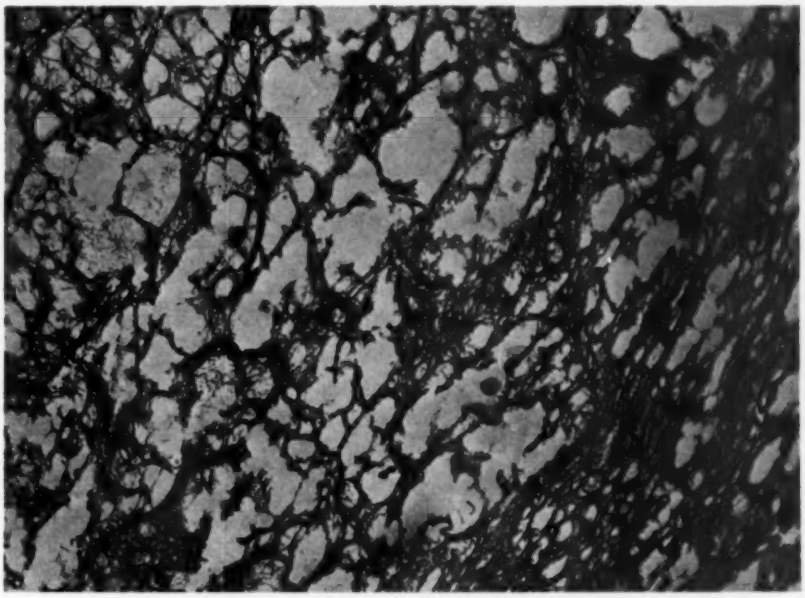


Fig. 1. Capillary and cavernous hemangioma showing the capillary and cavernous spaces.

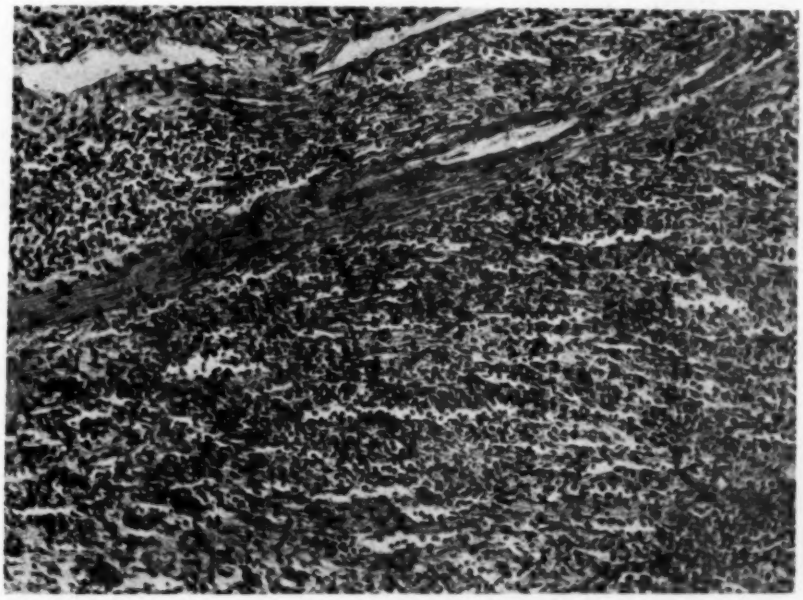


Fig. 2. Compressed splenic tissue showing obliteration of malpighian bodies.

Macroscopic Patbology. The spleen measured 36 × 26 × 12 cm. and weighed 7,240 Gm. It was dark blue in color, had a thickened capsule, and on cut section, was hemorrhagic and more or less compact. It contained numerous small cavities, but no large ones.

A diagnosis of capillary and cavernous hemangioma (telangioma) was made by three pathologists, Dr. Halis Sarikadioglu and Professor Hamdi Suad, of Istanbul, Turkey and Dr. A. C. Broders of the Mayo Clinic.

DISCUSSION

The case is remarkable on account of the great size and weight of the spleen. In analyzing the twenty-one cases previously reported, one can see that among the etiologic factors sex does not play any role, as the ratio of men to women is about equal. The neoplasm usually appears in the third or fourth decade of life, although a case has been reported in a four months old baby. No suggestive symptoms of hemangioma of the spleen exist; the essential findings are usually limited to a tumor in the abdomen, especially in the splenic region, loss of weight and some gastric and colonic disturbances. No remarkable change in the hemogram occurs. Splenectomy is the treatment of choice.

REFERENCES

1. Benekendroff, E. Untersuchungen eines aungiomes der Milz. *Virchow's Arch.*, 194: 500–514, 1908.
2. Dowd, C. N. Cavernous angioma of the spleen. *Ann. Surg.*, 62: 177–181, 1915.
3. Grove, L. W. Fibro-angioma of the spleen. *Ann. Surg.*, 105: 969–979, 1937.
4. Hains, C. E., and McIlroy, P. T. Spontaneous rupture of a cavernous angioma of the spleen. *J. A. M. A.*, 100: 1862–1863, 1933.
5. Hoge, Jr. Angioma cavernous of the spleen. *Med. Rec.*, 48: 418, 1895.
6. Humans, J. Report of a case of cavernous angioma of the spleen. *Ann. Surg.*, 25: 732–739, 1897.
7. Kellert, E. Diffuse hemangioma of the spleen. *Am. J. Cancer*, 16: 412–418, 1932.
8. Lubarsch, O. Gewächse und nicht parasitäre Zystem der Milz. *Hand. d. spec. path. Anat. u. Hist.*, 2: 699, 1927.
9. Matas, Rudolph. Cited by Grove, L. W.
10. McLaughlin, C. W., and Beck, J. S. P. Multilocular cystic lymph-angioma of the spleen. *Arch. Path.*, 15: 655–664, 1933.
11. Mikami, M. Über einen Fall vom Multiplen kavernösen Hämangiom der Milz. *Keijo. J. Med.*, 4: 53–55, 1933.
12. Muller, H. Über multiple Capillarangiome der Milz. *Virchow's Arch.*, 238: 76–80, 1922.
13. Näher, H. Über Hämangiome der Milz. *Deutsch. Ztschr. f. Chir.*, 191: 87–90, 1925.
14. Ombrédanne, L., and Martin, A. Angiome de la rate—splénectomie—guérison. *Bull. et mem. Soc. anat.*, 79: 59–60, 1904.
15. Orlandi, N. Primäres, diffuses Hämangioendotheliom der Milz. *Virchow's Arch.*, 269: 152–159, 1928.
16. Palavecino, I. R., Villegas, R. R., and Palazon, J. M. Angiomatosis del bazo. *Semana med.*, 2: 82–88, 1932.
17. Schwartz, F. Über ein primäres Hämangiom der Milz von seltener Gröbe, *Beit, z. klin. Chir.*, 150: 130–134, 1930.
18. Steden, E. Über ein aussergewöhnlich grosses kavernöses Hämang. der Milz. *Arch. f. klin. Chir.*, 130: 616–620, 1929.
19. Wassiljeff, A. A., and Protassewitsch, A. W. Über die diffuse Hämangiomatose der Milz. *Virchow's Arch.*, 979: 79–84, 1931.
20. Zeno, A. and Cid, J. M. Hémangio-endothéliome de la rate. *Ann. d'anat. path.*, 9: 583, 588, 1930.

NEW INSTRUMENTS

AN ATRAUMATIC NEEDLE FOR FASCIA SUTURES

J. Dewey Bisgard, M.D.

Assistant Professor of Surgery, University of Nebraska College of Medicine

OMAHA, NEBRASKA

FASCIA threaded through the eye of the standard needle used for fascial sutures produces a mass at the end of

Fig. 1.

the needle which is considerably larger than the needle itself. In my experience the resistance offered to passage of this mass through the channel cut by the needle causes tearing and undesirable insult to tissues through which it passes. To obviate this difficulty the needle illustrated was designed. (Fig. 1.)

The head of the needle contains a slot into which one end of the strip of fascia is inserted. This is accomplished simply and quickly by holding the fascia taut between two tissue forceps while the needle is slipped on obliquely as shown in Figure 2.

To secure the fascia in place, two devices have been used and have proved equally satisfactory. Accordingly, there are two

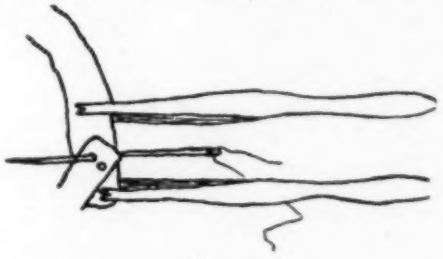


Fig. 2.

types of needles available. In the one illustrated here, the fascia is engaged by a silk suture passed through the drill holes in the flanges. In the other type the flanges are flexible and one has serrations along its edge. The fascia is gripped by squeezing the flanges together with a hemostat. The latter type can be applied more simply and although the flanges can be spread and compressed repeatedly, it is not indefinitely durable as is the former type. After the needle has been firmly fixed, the tissue protruding from the side of the needle is trimmed off with scissors.

A NEW WIRE GUN*

GORDON MONROE MORRISON, M.D.

SAN MATEO, CALIFORNIA

DIFFICULTY encountered introducing Kirschner wires, the most serious of which consisted of the winding up of tissues on the wire, prompted the writer to design a wire gun. Other difficulties too often encountered were slipping of the wire in a poorly fitted chuck, contamination of the field by using long unwieldy wire guides, tearing of gloves on the chuck, and the formation of ring sequestra in the bones. In the new wire gun, winding of the tissues on the wire is prevented by a reciprocating motion transmitted to the chuck. If the conventional rotary motion is desired for drills, the crank may be easily shifted to a position which will produce this motion. The chuck and carriage are through drilled so that the reserve wire is carried in the shaft and may be fed through the chuck as desired. A short optional sliding guide is also provided which allows any bone to be penetrated with two settings of the chuck. The chuck is of the key tightening variety and affords a positive grip on the wire.

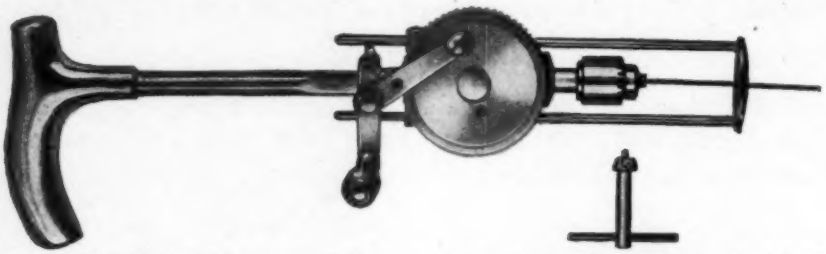


FIG. 1. Crank handle set to produce reciprocating motion of wire. Optional guide in place. Tissues cannot be wound on wire in this position.

FIG. 2. Guide removed and handle set to produce conventional rotary motion for use with drills or wire.

* The gun is manufactured by the J. Sklar Manufacturing Company, Brooklyn, New York.

[From Fernelius' Universa Medicina, Geneva, 1679.]

BOOKSHELF BROWSING

THE CONTRIBUTIONS OF NEW YORK TO AMERICAN GYNECOLOGY AND OBSTETRICS

EDWARD A. SCHUMANN

Professor of Obstetrics, University of Pennsylvania

PHILADELPHIA, PENNSYLVANIA

A VISIT to the City of the Famous Sky Line, offers much that is diverting and informing to the observant traveler from the interior. New York is the largest of the American villages, and among its miles upon miles of cavernous Main Streets, even a Sinclair Lewis would have cause to hesitate before characterizing its life.

The inhabitants of this metropolis exercise many quaint manners and customs (rather more of the latter than the former) and even the numerically negligible American portions of the population pass curious and interesting existences. Most of them seem to be of the cult of flagellants or self torturers, in that they seek to dwell as far as humanly possible from their places of occupation and twice daily subject themselves, voluntarily, to the most frightful struggles to secure places in noisome underground vehicles, wherein, amid agony and fearful noises, they strive to avoid suffocation long enough to be eructated from the bowels of the earth at their several destinations.

These unusual people have a single creed in life: "Bigger and Better," to which end they construct the largest and highest office building in the world, which is also, in consonance with their creed, the emptiest. Hospitals, they build in like fashion. Their medical centers are so gigantic that I am informed from creditable sources that 96 per cent of all obstetric patients are delivered somewhere between the entrance portals and the delivery room, the small remainder having their babies in taxicabs while en route to the hospital. These magnificent centers are, by an ingenious inversion of terms, invariably most remote from the center, so that in the time elapsing between the call to the obstetrician and his victorious passage to the institution through the well-known New York traffic, he is usually greeted by an experience-hungry intern with the information that the circumcision has just been successfully completed.

Naturally, from such a remarkable people, one would expect great advances in the medical sciences, and that this is true, we shall presently learn.

The Beginnings. In the history of the American colonies, only occasional mention is found of the assistance of male physicians in childbirth. Deliveries were usually aided by midwives, a good number of whom plied

their trade, especially in the northern colonies. Physicians were sometimes consulted in cases requiring embryotomy or some drastic variety of delivery. Gynecology, of course, was yet to be born a century later.

The first New York doctor deliberately to specialize in obstetrics was Dr. John Dupuy who flourished in the early years of the eighteenth century, dying in 1745. Dr. Dupuy was eminent in public affairs, and was a vestryman of Trinity Church, in whose churchyard he lies buried, his armorial bearing carved upside down upon his tombstone by a consciencious but non-heraldic stone-cutter. It is of interest that the first American obstetrician was connected by family ties with our own obstetrical family, the Hirsts, since Dr. Dupuy was a direct ancestor of Mrs. Barton Cooke Hirst.

Another early New York obstetrician was Dr. Peter Billing, of whom a brief reference is made in the New York Gazette for December 16, 1751, as an experienced physician and male midwife.

During these formative years, there was little or no obstetric surgery. Patients were generally attended by midwives, and perished for lack of surgical intervention in cases in which this was imperative. Advanced extra-uterine pregnancy was occasionally recognized and operated upon by the surgeons of the day; the first American publication of such a case is from the pen of Dr. John Bard of New York and was read before the Society of Physicians of London by John Fothergill on March 24, 1760. It is the account of a case in which a woman became pregnant, had a few labor pains at the end of gestation but was not delivered. She presently regained her health, but noted "a large, hard, indolent tumor inclining a little to the right side." She again became pregnant and was delivered of a healthy child, the abdominal tumor remained unchanged. She subsequently developed temperature and fluctuation in the abdominal tumor. After consultation the tumor was diagnosed as an extra-uterine fetus and Dr. Bard incised the growth, evacuating a full term fetus with a quantity of pus. The patient made an uneventful recovery.

This John Bard had the advantage of good medical training, being apprenticed to John Kearsley (of Philadelphia, of course) where he practiced for seven years and married a niece of Mrs. Kearsley. Benjamin Franklin persuaded him to go to New York, by reason of the scarcity of physicians in that city, following an epidemic of yellow fever. He went and, prospering greatly, became one of the most distinguished of American earlier physicians (Cutter).

Cutter states that formal instruction in midwifery began in New York in 1767, with the organization of a faculty of midwives under the auspices of King's College, John Van Brugh Tennent (1737–1770) being appointed professor of obstetrics. Tennent was a highly trained Edinburgh man, but developed pulmonary tuberculosis shortly after his appointment and removed to the West Indies where he died of yellow fever.

He was succeeded in the chair of obstetrics by Samuel Bard, son of John, also of Philadelphia, who received his early training in America, then was apprenticed to Alexander Russell in St. Thomas's Hospital (London) and finally was graduated from Edinburgh in 1765. He was elected to the chair of theory and practice of medicine in King's College. After the death of Tennent, midwifery was added to this chair, constituting a combined professorship which Bard held until 1776.

Bard's life is a most interesting one, personal attendance upon George Washington during the later's stay in New York being among his activities. He was also influential in bringing about the establishment of the New York City Public Library and the New York Dispensary. Dr. Bard's most important contribution was his "A Compendium of the Theory and Practice of Midwifery" (1807), the first formal work on obstetrics from the pen of an American physician. The reputation of the

author was of the highest, and the book went through three editions. It was then enlarged and again three editions were sold. Perusal of this book will persuade the reader that in Samuel Bard, America had produced an obstetrician far in advance of his time, indeed a conservative who would fit perfectly into the obstetric thought of today.

John W. Francis (1789–1861) was one of the most learned of the New York obstetricians, a student under David Hosack, who had been Bard's successor. He became professor of obstetrics and diseases of women and children in the College of Physicians in 1819, and was also one of the founders of Rutgers Medical College, where he held a second chair of obstetrics. He was devoted to general literature and hence was not a prolific medical writer.

Many medical historians, including Dr. Irving S. Cutter, consider Gunning S. Bedford as the most striking and forceful figure yet produced in American obstetrics. Destined to study law, Bedford changed his plans and graduated from Rutgers Medical College in 1829. After two years of European study, he returned to the United States and eventually located in New York, where he was prominent in the establishment of the Medical School of New York University in 1841. Dr. Bedford was professor of obstetrics in this institution until 1864, when he resigned by reason of ill health.

He published two books which had a wide circulation and exerted much influence both at home and abroad. "The Diseases of Women and Children" appeared in 1855 and the more important work, the "Principles and Practice of Obstetrics," was published in 1861. This was a really scholarly and scientific work and excited great enthusiasm. The Edinburgh Medical Journal said, "The book is, as a whole, so good, that we wish our readers to be impressed with a sense of its soundness, readableness and worth. We can, therefore give Dr. Bedford's volume no higher praise than to say it is remarkable among its contemporaries for soundness in scientific view, readableness as a literary composition, and worth as a guide of practice. This work will repay reading and it seems regrettable that Dr. Bedford's preëminent contribution should be so little known by the obstetricians of our time."

James D. Trask was another New York teacher and writer on obstetrics of the highest quality. He was a modest and unassuming man, who resigned his professorship at Long Island College to devote himself to his private practice in Astoria, L. I. In his Memoirs of Dr. Trask, written for the American Gynecological Society, Fordyce Barker says: "Few men in the profession have done such good work as he, and none were more highly respected by the best men in the profession." In the community where he lived, he was universally beloved and commanded the most perfect confidence as a physician and the highest respect as a man.

Dr. Trask's monograph upon "Rupture of the Uterus" was by far the most valuable to be published upon the subject at this time. Barker says "Since its publication, all obstetric works refer to it and I think it safe to say that the conclusions of Dr. Trask are accepted by educated and intelligent obstetricians of every nationality as guiding rules of practice in the presence of this fearful accident of parturition."

In 1855 Dr. Trask wrote a ninety-four page essay upon the "Statistics of Placenta Previa" which received the prize of the American Medical Association and excited the most profound influence upon the management of this lesion.

A little known, but most important contribution to medicine was made by Dr. John Stearns of Saratoga County, New York, in a letter to the Medical Repository in 1807. Here Dr. Stearns gives an account of the therapeutic use of ergot, which he calls pulvis parturiens, and states that he has used this preparation successfully in his practice. "It expedites lingering parturition and saves to the accoucheur a considerable

portion of time, without producing any bad effects on the patient," was his comment.

The steady growth of scientific principles in the profession and the progress of clinical medicine and surgery, led to the rapid expansion of hospitals, clinics and medical schools. In New York City, the New York Dispensary and the New York Hospital were opened in 1791, the New York Lying-In Hospital in 1798, and Bellevue Hospital in 1816.

McDowell's ovariotomy had focused the attention of the surgical world upon the possibility of laparotomy. The stage was set for the development of a new specialty and soon its boards were to be trod by the real founder of operative pelvic surgery, James Marion Sims (1813–1883). Born in Lancaster, South Carolina in 1813, Sims studied medicine at first under a preceptor, later graduating at Jefferson in Philadelphia in 1835, and settling into practice in Montgomery, Alabama.

Sims' triumph over that scourge of women, vesicovaginal fistula, is an old story to all of us and needs no repetition here. Coming to New York on account of his health, on his own initiative and by his own force alone he founded the Women's Hospital in the State of New York, the first special hospital for gynecology in the United States and one which still maintains its high standard as the ideal training ground for the intending specialist in this field. Sims spent much of his time abroad, practicing, demonstrating his operation for fistula and awaiting the end of the Civil War. During this period he wrote his somewhat revolutionary book, "Notes on Uterine Surgery," which achieved great success in the profession. Returning to America, he became involved in a controversy at the Women's Hôspital and was eventually forced from its staff. This incident is still too fresh to bear much discussion and is at best not particularly relevant to this sketch. Sims was probably the best known American physician of his generation. His life abroad, his spectacular and highly successful operation for the relief of an otherwise incurable condition, together with his rather histrionic personality all combined to make him a figure of international recognition.

In a personal letter to the present writer, Howard Kelly comments that "the best thing Sims ever did for gynecology was to get hold of Thomas Addis Emmet as his assistant. Dr. Emmet married a lady who was known to Sims and when the latter was in search of an assistant at the Women's Hospital, he learned that Emmet was in New York and selected him for the post. Dr. Emmet was apprenticed assistant in 1855 and served in that capacity until 1862, when he was appointed to succeed Sims as Chief, which position he held until 1900.

It is to Emmet that America owes its preëminence in plastic surgery, for he explored the whole field of vaginal operative gynecology, establishing principles and procedures which are still inviolate. His origination of trachelorrhaphy, his extensive perineorrhaphies and his improvement in the Sims fistula operation are perpetual contributions. Dr. Emmet's book, "The Principles and Practice of Gynecology," appeared in 1879 and went through three editions within fifteen months, being translated into French and German.

He was a systematic man, who kept meticulous records and case histories, often illustrating the lesions noted on the margins of the record. From all standpoints Emmet probably did more to advance pure gynecology than any other man, and New York justly honors his memory.

In the discussion of the Women's Hospital and the men who contributed so largely to its fame, the work of James B. Hunter should receive recognition. A self-made man, twenty years a general practitioner before becoming a pure specialist, Dr. Hunter possessed a gynecologic training probably superior to that of any of his contemporaries. Associated in his earlier years with Sims and Peaslee, and later with Thomas and Emmet, he profited so

well by his exceptional opportunities, that he represented all that was best in those honored teachers, the living and the dead. He was renowned for his acuteness as a diagnostician and his marvellous dexterity as an operator. Hunter was not a prolific writer and died in his prime, but his gifts rendered him a successful and highly respected teacher.

There remains to be considered the work of a group of men whose personalities and whose scientific achievements have probably not received the acclaim which is their due. Probably the greatest of these was Edmund Randolph Peaslee, of whom Howard Kelly says in a letter to the writer, "He was a true scientist, greater than Sims or any of the others of his time. His book remains a classic and he never has been given sufficient credit." Dr. Peaslee was a Massachusetts man, born in 1814. Graduating in medicine at Dartmouth and later Yale, he was shortly elected to the chair of anatomy and physiology at Dartmouth Medical College as successor to Dr. Oliver Wendell Holmes. Later he was appointed to the chair of gynecology which he held until his death. Peaslee was also professor of anatomy and surgery at Bowdoin, and at the same time active as professor of physiology and pathology in the New York Medical College. Afterwards he held the chair of obstetrics and diseases of women in the same institution. In 1874 he became professor of gynecology in Bellevue. It is worthy of mention that in his long career of thirty-seven years as professor in different medical colleges, he never was compelled by illness to give up a lecture until the Friday before his death. He was one of the surgeons to the Women's Hospital from 1872 until he died. Dr. Peaslee was active in medical societies, serving as president to seven important scientific organizations, including the American Gynecological Society. He was a prolific writer, his great work, "On Ovarian Tumors," remaining as a model among medical monographs.

Peaslee had great capacity for continued work and wonderful endurance. Yet his physical organization did not indicate this quality. Oliver Wendell Holmes spoke of him in a letter in the following characteristic fashion, "Peaslee's loss must be very much felt in town and country. He succeeded me as Professor of Anatomy and Physiology at Dartmouth in 1841. He looked there as if his circulating capital might be a hundred or two red globules, with twice as many white ones in half a pint of serum, yet he outlived scores of prize-fighters, and looked better when I saw him some months ago than as I remembered him then."

Fordyce Barker was for a quarter century the dominant figure in New York medicine. One of the Founders of Bellevue Hospital Medical College, he filled the chair of obstetrics and diseases of women from its inception until his death.

Early in his career, Dr. Barker strained his voice and ever after labored under the disadvantage of having only a hoarse whisper at his command, due to partial paralysis of the vocal cord. This misfortune would have turned a lesser man from a public career, but he persevered in his lecturing and public speaking to the end of his life, always making himself heard and causing his audience to forget the imperfections of his voice by the charm of his eloquence and the purity of his diction.

Dr. Barker always remained a general practitioner and developed a practice which is still spoken of with awe by physicians who knew of its power and extent. "Physician to the nobility" he was called, and it is said that his case book read like a combined Social Register, Who's Who and Financial Directory of New York and neighboring states. Dr. Barker wrote well, but contributed little of permanence to medical literature. He was essentially a clinician and his fame rests upon the affection and respect in which he was held by his many patients and his medical confrères.

In John Byrne, we find a man of entirely different stamp. An Irishman, educated in

medicine at Belfast, Dublin, Glasgow, and Edinburgh, he came to Brooklyn and rapidly rose to a commanding position in practice and in public affairs. In 1857, he was instrumental in founding a dispensary and hospital which in the succeeding year was incorporated as the Long Island College Hospital. For a time he held the clinical professorship of uterine surgery in this institution. For many years Dr. Byrne controlled the largest hospital service in Brooklyn, had the largest private clientèle, and ranked as the leading consultant in his special field.

His great contribution to gynecology was his wide cautery dissection in cervical carcinoma, and his results, so brilliant as often to be challenged during his lifetime, remained as possibly the best statistics in the cure of this dread disease, until the advent of radium improved the figures.

Alexander J. C. Skene was a Scot by birth, a scion of the old Aberdeen family of that name. He came to America at the age of 19, studied medicine in Toronto and Michigan and was graduated from Long Island College Hospital in 1863. Following a war service, Dr. Skene entered practice in Brooklyn and soon became professor of gynecology at Long Island, where he was most active in securing practical and beautiful plans giving adequate expression to the great Polhemus gift of a college and clinic building. Dr. Skene was a founder and president of the American Gynecological Society and a prolific medical writer. He remains known to posterity by his observation upon the urethral glands, which bear his name. He was a skilled sculptor and spent his spare time in modelling portraits of animals in his mountain retreat in the Catskills.

T. Gaillard Thomas, a South Carolinian by birth, received his medical education in the Medical College of Charleston in 1852. Coming to New York, Dr. Thomas established a quiz class in obstetrics which soon attained a wide reputation. He later became lecturer on obstetrics in New York University and attracted large audiences by his brilliant and entertaining presentation of the subject. He finally became professor of obstetrics at the College of Physicians and Surgeons and held that post for a number of years.

Dr. Thomas' name is especially identified with his operation, laparo-elytrotomy, which he presented to the profession as a substitute for the classical cesarean section. Its principles have became incorporated in operative obstetrics, and it is still in quite general use, though in somewhat modified form. He was a member of the leading obstetrical Societies of the world and was a most impressive figure in New York Medicine.

The development of gynecologic and obstetrical pathology was slow in America and one must mention a pioneer in this branch, Dr. Henry C. Coe, still living, but now in retirement, whose many publications presented this specialized pathology to the profession.

Also, there must be a tribute paid to the genius of Paul F. Mundé, the German scientist who, as its brilliant editor, placed the American Journal of Obstetrics in its enviable position as the educator of the American specialist. Dr. Mundé was followed in his editorial chair by Dr. Brooks H. Wells, who maintained this journal in its high estate until his untimely death following a bicycle accident.

One might prolong this list indefinitely. Names of men mighty and puissant in the profession come crowding into memory and the biographer finds himself at a loss to determine their order of precedence in the work to which they devoted their lives. Gill Wylie, the sportsman, he who gave the intra-uterine stem to relieve suffering thousands of their dysmenorrhea, Polk, Cragin of the velvet hands, the genial Studdiford, the flamboyant and lovable Florian Krug, Edebohls of the ubiquitous stirrups, Jewett, Lusk whose midwifery still remains a classic, the modest but brilliant Pomeroy, Garrigues, Goffe and lastly that man whose love of his work, whose open mind and whose devotion to

teaching made him an inspiration to this writer, John Osborn Polak.

New York's contribution to gynecology and obstetrics has not closed with the passing of the great physicians whose attainments have been so hastily characterized. The work goes on, the torch burns with an ever brightening luster and one can discern in the eager younger hands that are reaching up to grasp the beacon and carry it on, that these contributions will not fail in the years to come. It would be a most congenial task to chronicle the work done and being done by those colleagues of our own generation. Time, however, does not serve, nor is the occasion auspicious for an appraisement of the men now active. Suffice it to say, that we rest content in the knowledge that in your hands gynecology and obstetrics will continue to develop and broaden in scope, in the future, as in the past.

This brief sketch, begun on a note of friendly irony, ends with a sense of the deepest affection for the living, and of profound respect for the dead members of our well beloved specialty, together with full appreciation of the obligation to them, which rests upon all of us, who labor in our chosen field of medical endeavor.

Honest sympathy and understanding must be acquired and practiced outside as well as inside the sick-room.
From—"Disease and the Man" by Roger F. Lapham (Oxford).

BOOK REVIEWS

THE PRACTITIONERS LIBRARY OF MEDICINE AND SURGERY. Volume XI. Eye, Ear, Nose and Throat. New York: D. Appleton-Century Co., Inc. 1937. Price $10.

These volumes, of which this one is the eleventh, are under the general editorial supervision of Dr. George Blumer, Professor of Medicine, Yale University School of Medicine. This volume, devoted to articles on the eye, ear, nose and throat, has been edited by Dr. Arthur M. Yudkin and Dr. Paul B. MacCready, which in itself is a guarantee that the chapters and authors have been selected with care and discrimination. Throughout, in this series of books, emphasis has been laid upon diagnosis and treatment.

Newer methods and newer conceptions have brought the contents up to date.

Part One deals with Ophthalmology, and the chapters cover, Diseases of the Conjunctiva, Diseases of the Eyelids, Diseases of the Cornea, Diseases of the Lacrimal Apparatus, Diseases of the Sclera, Diseases of the Uveal Tract, Diseases of the Crystalline Lens, Diseases of the Vitreous, Diseases of the Retina, Diseases of the Optic Nerve, Traumata of the Orbit and Its Contents, Glaucoma, Diseases of the Extra-Ocular Muscles, Refraction, Ocular Manifestations of Diseases of the Nervous System, and Ocular Manifestations of Constitutional Diseases.

Part Two deals with Diseases of the Ear, and covers, Physiology and Histopathology of the Middle Ear, Clinical Application of Physiology and Histopathology of the Study of Suppurative Lesions of the Middle Ear, Diseases of the External Ear, Acute Inflammatory Disease of the Middle Ear, Acute Suppurative Mastoiditis, The Chronic Otorrheas, Complications of Suppurative Otitis Media, Systemic and Intracranial, The Surgical Treatment of Facial Palsy, The Physiology of the Internal Ear, Diagnosis and Treatment of Deafness, The Audiometer, Vertigo, and Trauma and Occupational Disturbances of the Ear.

Part Three covers Diseases of the Nose, Nasopharynx and Sinuses, and the chapter headings are: The Physiology of the Upper Respiratory Tract, Histopathology of the Nasal and Sinus Mucosa, Clinical Application of Physiology and Histopathology of the Nose and Its Accessory Sinuses, General Consideration, The Common Cold, Catarrhal and Obstructive Affections of the Nose and Nasopharynx, Fractures of the Nasal and Malar Bones, Epistaxis, Malformations, Chronic Infective Diseases and Other Conditions of the Nose, Acute and Chronic Sinusitis, Acute Suppurative Sinusitis in Children, Allergy of the Nose and Paranasal Sinuses, The Sinuses in Relation to Other Diseases, Complications of Nasal Accessory Sinus Disease, Operative Treatment of Inflammation of the Nasal Accessory Sinuses, Neuralgia of the Head and Face Distinct from Trigeminal Neuralgia, and Malignant Disease of the Nose and Accessory Nasal Sinuses and the Nasopharynx.

Part Four covers Diseases of the Pharynx, and deals with General Considerations of the Pharynx, Acute Infections of the Pharynx, Chronic Diseases of the Pharynx, Diseases of the Tonsils and the Adenoids. Acute Suppuration in the Deep Structures of the Neck, Malignant Disease of the Laryngopharynx, and Branchial and Thyroglossal Duct Cysts and Fistulas.

Part Five deals with Diseases of the Larynx, and has chapters on General Considerations Concerning the Larynx and Trachea, Common Diseases of the Larynx in Children, Acute Fulminating Laryngotracheobronchitis, Common Diseases of the Larynx in Adults, Carcinoma of the Larynx, Tracheototomy, Laryngeal Neuropathies, Injuries of the Larynx; The Voice in Relation to Disease, and Peroral Endoscopy.

From this outline one notes that these fields have been thoroughly covered. Inasmuch as each chapter has been written by an outstanding man in his field, one, also realizes that this work is authoritative.

This volume of 1153 pages is profusely illustrated, and has an ample Index.

THE PITUITARY GLAND. AN INVESTIGATION OF THE MOST RECENT ADVANCES. Proceedings of the Association for Research in Nervous and Mental Diseases. Baltimore, 1938. Williams and Wilkins. Price $10.00.

Under the editorship of Walter Timme, Angus M. Frantz and Clarence C. Hare, a group of noteworthy contributors have brought together in one volume the available knowledge of the pituitary gland, covering its anatomy, histology, physiology, and the manifestations of its aberrations. Both the neurologist and the endocrinologist are well represented in this symposium. Forty-six authorities took part, including Wayne J. Atwell, J. B. Collip, Leo M. Davidoff, Cornelius G. Dyke, Herbert M. Evans, Max A. Goldzieher, W. W. Herrick, Gilbert Horrax, Raphael Kurzrok, A. T. Rasmussen, Oscar Riddle, Hans Selye, A. E. Severinghaus, Philip E. Smith, Charles R. Stockard, Frederick Tilney, and numerous others equally prominent in the field.

The completed volume of 764 pages represents the seventeenth monograph produced by the Association for Research in Nervous and Mental Diseases—the proceedings of a session devoted exclusively to this most interesting and most important of the glands of the endocrine chain. The articles are of a high order, each contributor having restricted himself to his own subject and offering a complete survey of its present status. From a consideration of the anatomy and histology of the gland, one advances to a study of each of the hypophyseal hormones and functions in turn, then to a discussion of the relationship of the pituitary to the physiologic functions of pregnancy, puberty and the menopause, the bearing of the gland upon body form, personality and behavior, and finally to descriptions of the pituitary syndromes and their treatment.

The completeness of the volume is truly remarkable. In addition to the pituitary influence upon metabolism, growth, sexual development, lactation, etc., many less familiar phases of the subject are attacked: the relationship of the anterior lobe to cancerous growths; pituitary effect upon cranial form and structure; pituitary effect upon constitutional and genetic factors, etc. Dr. Timme has made a study of the distribution of pituitary syndromes, indicating the possibility of a "pituitary belt" analogous to the well known "Thyroid belt." Patients with pituitary disorders in the United States, he finds, tend by birth or familial origin to be products of the Middle West and Great Lakes regions.

The surgical and radiologic treatment of pituitary tumors is outlined, as well as methods of diagnosis and treatment in the more common pituitary disorders, Frohlich's syndrome, acromegaly, dwarfism, etc.

To the specialist this volume is a gold mine of information, since it covers authoritatively a much disputed subject. To the general practitioner and medical student, it will probably remain a work of reference, valuable because it brings up to date one portion of much discussed and constantly changing field. The Association for Research in Nervous and Mental Disease may well be proud of the high standard maintained in all forty-two chapters and the excellence of the plan of organization which integrates them.

THE SURGICAL TREATMENT OF HYPERTENSION. By George Crile, M.D. Edited by Amy Rowland. Philadelphia, 1938. W. B. Saunders Company, Price $4.00.

In his preface the author writes the first paragraph of his own book review. We quote him: "During recent years there has been a crescendo of interest in the attempts which have been made by various surgeons to treat essential hypertension by surgical procedures. It becomes an important matter therefore to determine whether or not essential hypertension is amenable to surgical treatment and to what extent. . . . It is for this purpose that this volume has been prepared. It is not a formal treatise on the subject of hypertension, but it presents rather the conception of the genesis of essential hypertension in accordance with which a plan of operative treatment has been formulated; it describes the surgical procedures which we have employed; gives the results of these procedures and reviews what others have done in the field of the surgical treatment of essential hypertension."

Needless to say the book is well written, the illustrations are good. It should have an appeal to internists and to surgeons interested in this subject.

A reading of its 239 pages (fifty-two illustrations) will bring one up to date on this topic.

There are references at the conclusion of each chapter, and an index of names and subjects.

Sulfanilamide Therapy of Bacterial Infections. With Special Reference to Diseases Caused by Hemolytic Streptococci, Pneumococci, Meningococci and Gonococci. By Ralph R. Mellon, M.D., Paul Gross, M.D., and Frank B. Cooper, M.S. Springfield, Ill., 1938. Charles C. Thomas. Price $4.00.

Sulfanilamide compounds were introduced from abroad into this country, and shortly thereafter the lay press, playing only the dramatic highlights, made it known not only to the man on the street but to most physicians. As a result it has been administered by physicians for a host of human ailments, often without rhyme or reason, and in a large percentage of cases the physician has known nothing concerning the drug except one of its proprietary trade names.

This sound book is therefore doubly welcome at this time. And although the book is designed to appeal to various technical and research specialists, it should have a wide distribution among practitioners of medicine in its several specialities.

The volume is divided into four sections. Section I (seven chapters) is a review of earlier literature dealing with the chemistry and pharmacology of the sulfonamide compounds and their experimental and clinical employment. Section II (three chapters) deals with the authors' experiments with the bacteriostatic effects of sulfanilamide in vitro and the results of therapy with sulfonamide compounds on streptococcal and pneumococcal infections in laboratory animals, and observations on the clinical use of these compounds in pneumonia and streptococcal meningitis. Section III (four chapters) covers the mechanism of action of sulfonamide compounds and the mobilization of the defensive factors of the host. Section IV (two chapters) surveys general chemotherapeutic considerations and the criteria of therapeutic efficiency.

Even after the manuscript had gone to press, "a number of important studies appeared, some of them on new aspects of the action of sulfonamide compounds. A number of these it was possible to incorporate in the original text; the others are included" in the Addenda. Thus, it is seen that this volume is as up to date as it was humanly possible to make it.

Many physicians have found sulfanilamide a valuable and marvelous drug. But it is a drug one should know about from every possible angle . . . and there are several such angles. The authors of this work should be congratulated in offering the profession a work of this type. We hope a large number of physicians will read it.

SPECIAL ARTICLE

Further Studies of the Krukenburg Tumor of the Ovary

BY

JULIUS JARCHO, M.D., F.A.C.S.

Attending Gynecologist and Obstetrician, Sydenham Hospital

AMERICAN JOURNAL OF SURGERY, Inc.

NEW YORK • MCMXXXVIII

FURTHER STUDIES OF THE KRUKENBERG TUMOR OF THE OVARY*

JULIUS JARCHO, M.D., F.A.C.S.

Attending Gynecologist and Obstetrician, Sydenham Hospital

NEW YORK CITY

THE ovarian tumors now known as Krukenberg tumors were first described by Friedrich Krukenberg of Marburg in 1896, on the basis of five cases reported at that time.

Krukenberg stated that these tumors cause an enlargement of the ovary, which retains its normal form, and that the surface is smooth or may be slightly bosselated (höckerig). On section, neoplasms of this type show a generally solid tissue, especially near the periphery. The inner portion is more myxomatous, occasionally showing some cystic formation.

Similar tumors had undoubtedly been described in the literature previous to 1896, however. For instance, I find an interesting case mentioned in the *Descriptive Catalogue of the Pathological Specimens Contained in the Museum of the Royal College of Surgeons of England* (Vol. 1), as early as 1846. The following gross description leads me to believe that this neoplasm was a Krukenberg tumor: "Section of an ovary, in which all natural texture has disappeared, and its place is occupied by a nodulated mass of uniformly hard, heavy, milk-white, compact, obscurely fibrous substance. The mass is of a round-oval form, and measures about an inch and a half in its principal diameter.

"Patient was a woman 49 years old, eighteen years married, and the mother of eleven children. She had scirrhous cancer of the submucous tissue and disease of the muscular coat of the stomach, exactly similar to that shown in the preceding specimen. The other ovary was similarly diseased."

Histologically the stroma, as described by Krukenberg, was the connective tissue of the ovary showing proliferation of a

* From the Department of Obstetrics and Gynecology, Sydenham Hospital, New York City. Delivered in abstract form at "The Clinical Lecture," Sydenham Hospital, March 24, 1938.

sarcoma-like nature. Interspersed among the cells of this stroma were mucin-containing cells with the nucleus displaced to the periphery. The cells might be scattered or arranged in

FIG. 1. Krukenberg tumor of both ovaries, normal uterus. Note smooth bosselated ovarian surface and normal ovarian indentations. (From Jarcho, in *Am. J. Obst. & Gynec.* 13: 288, 1927.)

groups, in some areas showing a tendency to the formation of acini. Krukenberg recognized these cells as epithelial (carcinomatous) cells, but because of the nature of the stroma he designated this tumor as a fibrosarcoma, adding the qualifying phrase "mucocellulare carcinomatodes."

While neoplasms of this type are still known as Krukenberg tumors because of the fact that he was the first to call attention to them and describe them in detail, it has since been recognized that he made two errors in his interpretation of

their significance. In the first place, he described them as fibrosarcoma, while they are in reality carcinomata; in the second place, he described them as primary tumors, while they are actually secondary to carcinomata elsewhere, usually in the gastrointestinal tract, especially in the stomach, but sometimes in the breast.

Major has suggested that it would be better to reverse the order of the descriptive term employed by Krukenberg and designate the neoplasm as "carcinoma mucocellulare fibrosarcomatodes." Marchand also proposed changing the name of the Krukenberg tumor to "carcinoma mucocellulare," because he considered the characteristic cells to be of epithelial origin. This latter designation would, in my opinion, be more correctly descriptive, in spite of the fact that the mucinous changes may not be well expressed in all cases.

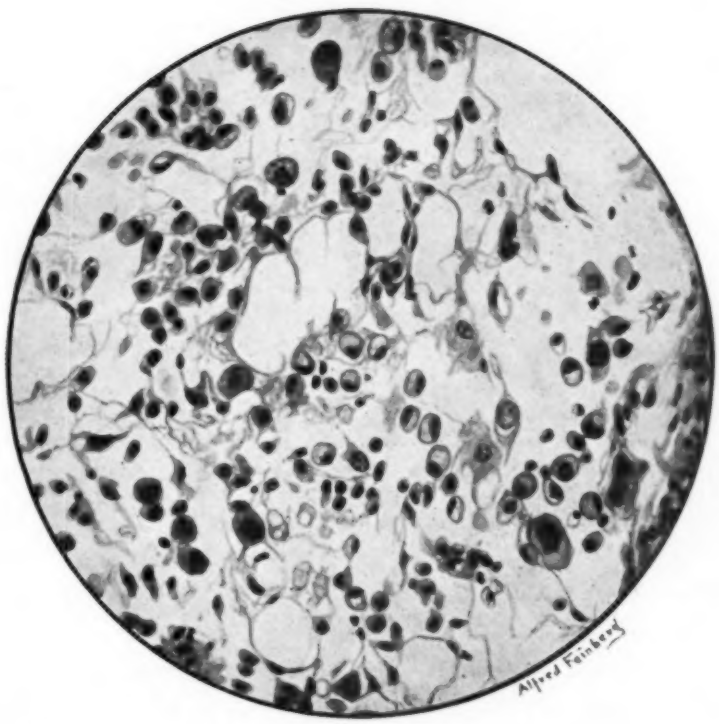
Krukenberg's failure to recognize the secondary nature of the tumor described by him may be due to the fact that his interest lay in the detailed study of the pathology of the ovarian tumor, in only one of his cases is a full clinical history given, and in another a history of gastric symptoms is noted. In none was pathologic examination of the gastrointestinal tract made. Failing to recognize the secondary nature of the tumor, Krukenberg was unable to determine the origin of the mucin-containing cells.

Pathologists who have studied tumors of the Krukenberg type are now convinced that there is no evidence that the stroma reaction is neoplastic or sarcomatous or that the large epithelial cells are derived from the stroma (Ewing).

According to Matters, Erdheim and Schiller showed the Krukenberg tumor to be "a pure carcinoma and always secondary to carcinoma of the gastrointestinal tract or of the gall-bladder." Willis, in describing the histologic characteristics of Krukenberg tumor, states that: "The tumour-cells are carcinomatous goblet-cells which have assumed the spherical signet-ring form in consequence of the yielding, almost semi-fluid nature of their hydropic stromal environment."

Shaw notes that the stroma of this type of tumor presents neither the infiltrating nor the metastasizing properties of sarcoma and that it indicates a reaction "in an extraordinarily

I



II

PLATE I. Krukenberg tumor of the ovary. In addition to signet-ring forms and degenerating shadow forms, there are occasional tumor cells in which the nucleus is centrally placed. Same as Figures 2 and 3.

PLATE II. Krukenberg tumor of the ovary. The tumor cells are in various stages of mucous degeneration. Some are mere shadows—many are typical signet-ring cells. Note hyperchromic nuclei—some centrally located—others approaching the periphery. (× 400.)

embryonic manner to the presence of carcinoma cells in its neighbourhood."

In discussing the pathology of the Krukenberg tumor, there

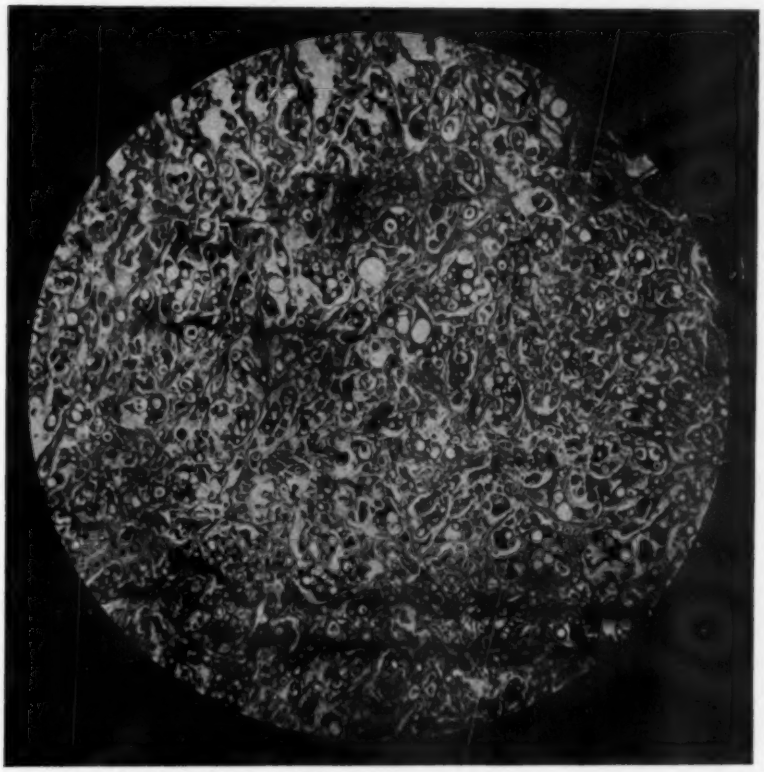


FIG. 2. Krukenberg tumor of the ovary. A dense stroma encloses groups of epithelial cells including signet-ring cells and shadow forms. (× 175.) Same as Figure 3 and Plate 1.

has been a tendency to place too much emphasis on the presence of the mucinous cells with the nucleus displaced to the periphery—the so-called signet-ring (seal ring) cells. Krukenberg did indeed describe these cells as characteristic of the tumors studied by him. But as the secondary carcinomatous nature of the Krukenberg tumor has been recognized, it has also been found that in tumors showing the gross characteristics of Krukenberg tumors the signet-ring cells may not be present at all, or may be present in only small numbers.

In the seven cases of Krukenberg tumor that I described in 1927, the tumors in most instances showed the typical structure with signet-ring cells arranged loosely or compactly between

connective tissue rich in spindle-shaped cells. In two cases, however, the growths showed structures resembling adenocarcinoma. In one of these, groups of mucinous cells occurred

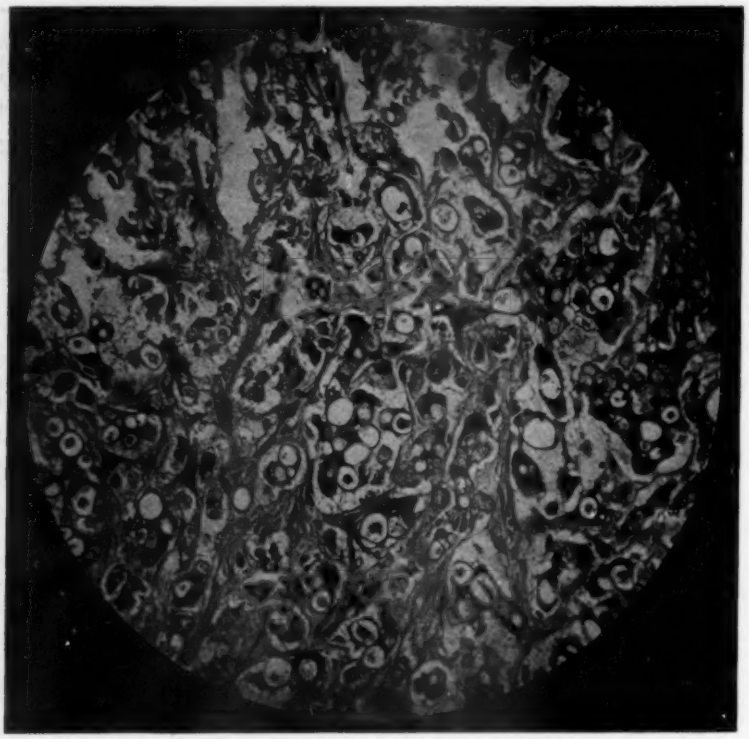


FIG. 3. Krukenberg tumor of the ovary. Note signet-ring cells and edematous connective tissue stroma. (× 350). Same as Figure 2 and Plate 1.

on the side of the atypical glands. In another case the mucinous degeneration of the epithelial cells was not well expressed. The fact that metastatic ovarian tumors showing the gross characteristics of Krukenberg tumors may not contain typical signet-ring cells has also been noted by others.

Thus Amann in 1906 stated that a characteristic type of metastatic ovarian tumor is "an edematous fibroma with epithelial, eventually mucous, degeneration." The Krukenberg tumor showing signet-ring cells is of this type, these cells representing mucinous degeneration of the epithelial elements. Of course in such tumors if mucinous degeneration is not advanced, the signet-ring cells would not be present in typical form, but in my opinion, such tumors would be, nevertheless, Krukenberg tumors.

Hundley notes that in eight cases of ovarian carcinoma secondary to gastric carcinoma there were three typical Krukenberg tumors. Furthermore, there were two medullary

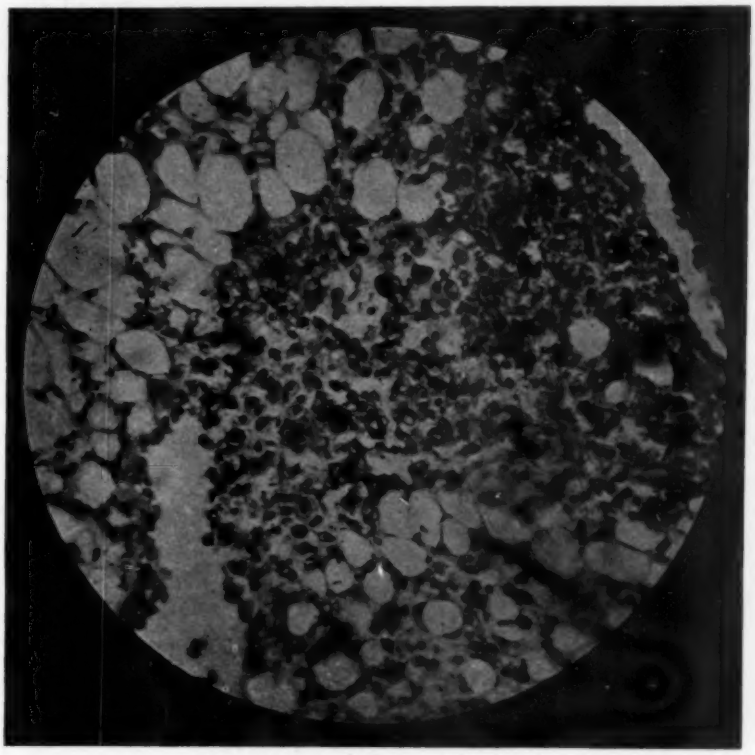


FIG. 4. Same as Plate II. (× 175.)

carcinomata in this group which were "similar in every way to those Krukenberg tumors except that they have no typical signet cells. . . . In one case of medullary carcinoma many large colloid cells are seen, but the nuclei are much larger and are centrally placed. One has the feeling that if there were more colloid in the cell the nucleus would be flattened out and pushed to the periphery, thus forming a typical signet cell."

In 1932 Shaw stated that in the same series of cases in which he had three cases of typical Krukenberg tumor, there was one atypical case, and he notes that he has seen four others of the same type, apart from this series.

He says that these tumors "correspond almost exactly with Krukenberg tumours in their naked-eye characters except that they have bossed surfaces and are somewhat larger. They are found in association with carcinoma of the stomach, are

bilateral, and are accompanied by ascites. They differ in their histology. They possess an embryonic stroma of spindle cells, but true signet-ring cells are absent. Carcinoma cells are

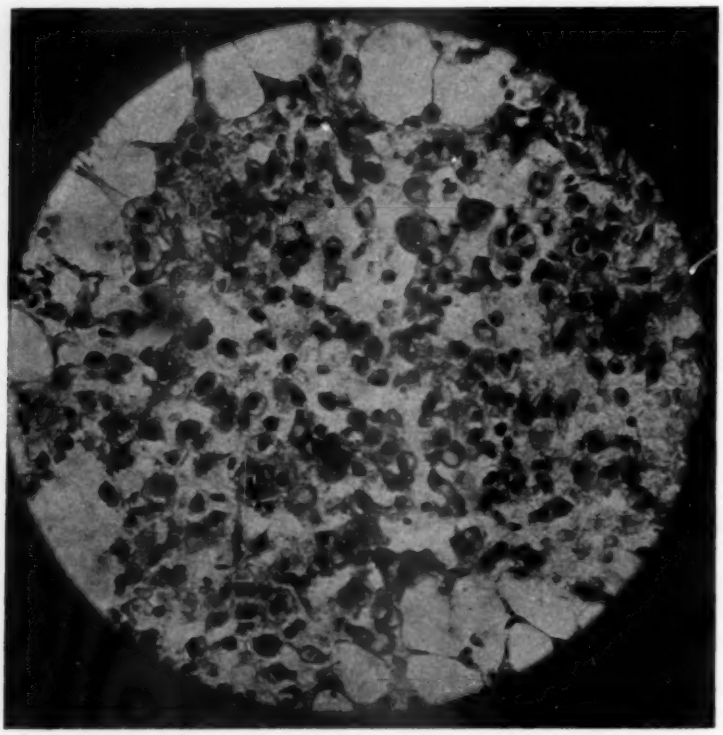


FIG. 5. Same as Plate II. (× 350.)

scattered irregularly among the stroma cells. The carcinoma cells show active mitoses; they vary in size from small spheroidal cells to large polyhedral cells. The cells can be demonstrated in lymphatic channels and there is not any evidence of surface invasion. All grades can be recognized from isolated carcinoma cells to well-developed acini, which resemble those of carcinomata. . . . The carcinoma cells, however, maintain their primitive characters and are not converted into signet-ring cells." Thus Shaw regards typical Krukenberg tumors as a more specialized form of such metastatic ovarian carcinoma in which the carcinoma cells become converted into signet-ring cells.

Armstrong reports a case of Krukenberg tumor in which some of the cells were large with clear protoplasm and the nucleus displaced to the periphery, and others were smaller with granular protoplasm and central nucleus. Best's carmine

stain showed the large cells to be filled with mucin, while the smaller cells showed only "very scant deposits of mucin" or none at all.

It has interested me to note that in a very recent contribution by Novak and Gray, the significance of the typical signet-ring cell of the Krukenberg tumor is also discussed. These authors note one case that they include in their series of Krukenberg tumors in which the tumor showed some areas of "typical mucifying adenocarcinoma" and others with the typical Krukenberg structure and signet-ring cells "in large numbers."

In their series all gradations were found between the adenocarcinomatous structure to that of the tumor without any gland-like structure but with scattered cells or masses of cells of the signet-ring type. On the basis of these findings, Novak and Gray suggest:

"One finds transitional pictures which suggest the Krukenberg tumor may be only the end product of a mucoid adenocarcinoma which in the environment of the ovary assumes the features which we look upon as characteristic of the Krukenberg tumor."

On the other hand, it should be noted that Krukenberg cells may be present in the primary tumor, so that they are not necessarily characteristic of "the environment of the ovary." Also Krukenberg cells may be found occasionally in tumors in other organs without involvement of the ovaries. Thus Sternberg reports a case in a woman with multiple bone marrow tumors made up largely of typical signet-ring cells in which there was no involvement of the ovaries. Another case of interest is reported by Palazzo in which cutaneous carcinomata secondary to a gastric carcinoma in a man showed the cellular characteristics of Krukenberg tumor.

However, in many cases the primary tumor shows no signet-ring cells, or even mucin-containing cells, when these cells are found in the ovary.

All these statements, as well as histologic descriptions of other reported cases and the findings in my own cases, support my opinion that the so-called Krukenberg or signet-ring cell is but one feature of metastatic carcinomata showing the gross

appearance of the tumors described by Krukenberg—neoplastic enlargement of one or both ovaries without distortion, i.e., with preservation of the normal form of the ovary, and with smooth (non-nodular) surface.

Krukenberg tumors of the ovary, as stated, are now recognized as generally, if not invariably, secondary, and usually secondary to gastric carcinoma. Runyeon's table shows that in sixty-eight cases of Krukenberg tumor the primary tumor was in the stomach in fifty-four cases and in the breast in two cases. A few cases have been reported as primary in which no evidence of a primary tumor elsewhere has been found.

A case that he regarded as primary is reported by Andrews in 1933. Novak and Gray include it in their series, as they made the pathologic examination of the ovarian tumor which was a typical Krukenberg neoplasm. They state that the patient is living and without symptoms of carcinoma four years after operation.

Frankl also cites a case in which Krukenberg tumors of both ovaries were removed and the patient is living and well over three years after operation. The author regarded this case as primary as there were no symptoms of any gastrointestinal disorder and *x*-ray findings were negative.

Such cases as these would indicate the possibility of the Krukenberg tumor being primary in the ovary. However, I am of the opinion that better diagnostic procedure, repeated studies of the gastric contents, thorough Roentgen examination, as well as more careful exploration at operation, may disclose an early primary lesion. Furthermore, a thorough study of autopsy findings with meticulous histologic search of tissues may reveal the primary focus.

In the present state of our knowledge, however, we cannot completely exclude the possibility that in occasional instances the Krukenberg tumor may be primary in the ovary. In a personal communication, Professor Oskar Frankl states the opinion that the so-called Krukenberg ovarian tumors with signet-ring cells are very rarely primary, but that this may occur. Novak and Gray have stated, "There are . . . certain histogenetic possibilities in the explanation of primary ovarian

cancers which may assume the Krukenberg type." Thus a primary Krukenberg tumor of the ovary might start from mucoid epithelium similar to that found in pseudomucinous cystadenomata. It might also conceivably originate in the Walthard cell groups, which are believed to constitute the progenitor of the Brenner tumor. Hence, although we as yet cannot prove that primary Krukenberg tumors of the ovary do *not* exist—it is always difficult to prove a negative statement—yet it seems likely that as more and more care is devoted to the study of individual cases, the proportion of instances meriting inclusion under the rubric of primary Krukenberg tumor will steadily approach zero.

The method of metastasis of ovarian tumors is a question of fundamental importance. It has been suggested that the involvement of the ovaries may occur by continuity, i.e., directly from the surrounding tissues or organs. Propagation may also take place by implantation. According to this theory, the carcinoma cells penetrate the wall of the stomach, reach the peritoneum, and are carried down to the pelvis with the aid of the peristaltic intestinal movements; or possibly reach the posterior cul-de-sac along the aorta. But there are several characteristics of Krukenberg tumor that are against this theory. In the first place the primary tumor may be small and relatively superficial, and may not penetrate through the serosa, as, for instance, in the case recently reported by Simecek of Prague, in which the primary gastric cancer involved only the mucosa and submucosa, not penetrating even into the muscle of the gastric wall. Also the surface of the Krukenberg tumor is characteristically smooth, showing no surface nodules, such as would be present if metastasis had occurred by implantation.

Frankl recently stated: "I am sure that the so-called Krukenberg tumor (I never use the term Krukenberg tumor as I prefer the term metastatic carcinoma of the ovary) develops by a real metastasis and not by implantation."

In my own cases, previously reported, the ovarian surface was carefully examined in several blocks, and in no case were any deposits of tumor cells found in the surface layer, the tumor being present only in the deeper part of the ovaries.

Enzer also found no tumor cells on the outer surface of the ovary in "numerous sections" through the specimens in his case.

Metastasis of carcinoma may also take place by the blood stream, and cases have been reported of carcinoma of the breast with ovarian metastases in which transmission apparently occurred by the blood.

In Major's case with the primary tumor in the gastrointestinal tract, cancer cells were found in the pulmonary circulation, with microscopic metastases in the lung tissue, and Major considers that the ovarian metastases also occurred by way of the blood stream.

In the case reported by Simecek, widespread metastasis had occurred; there was evidence of metastasis by the blood stream to the adrenals and the bones, but lymphangitic metastasis to the ovaries and to the lungs was also demonstrated by the pathologic examination. The possibility of metastasis by the blood stream cannot be denied, but the evidence at hand does not indicate that it is the usual route of metastasis of Krukenberg tumor.

Krukenberg stated that the tumors described by him metastasized by way of the lymph glands, and in some cases the route of metastasis from the primary tumor to the ovaries can be demonstrated pathologically to be along the lymphatics. This was true in my own cases, in which the propagation of the carcinoma along the lymphatics could be followed in the pathologic specimens. Metastasis occurred in the lymphatic glands and lymphangitis cancerosa was observed. Simecek, as noted, reports similar findings in her case.

In gastric carcinoma the retrogastric lymph glands are frequently involved, from which metastasis may extend to the superior lumbar lymph glands. The ovarian lymphatics pass to the latter group of glands; and if these are involved, extension to the ovaries may easily occur, even though it is retrograde to the lymph flow. The possibility of retrograde lymphatic dissemination of carcinoma, Novak states, "has been well established and is accepted by all pathologists."

Shaw states his opinion very definitely that in the case of Krukenberg tumors, "the evidence is in favour of the ovaries

being invaded by way of the lymphatics, by retrograde lymphatic spread along the ovarian lymphatics."

Fallas, who considers that the theory of metastasis to the

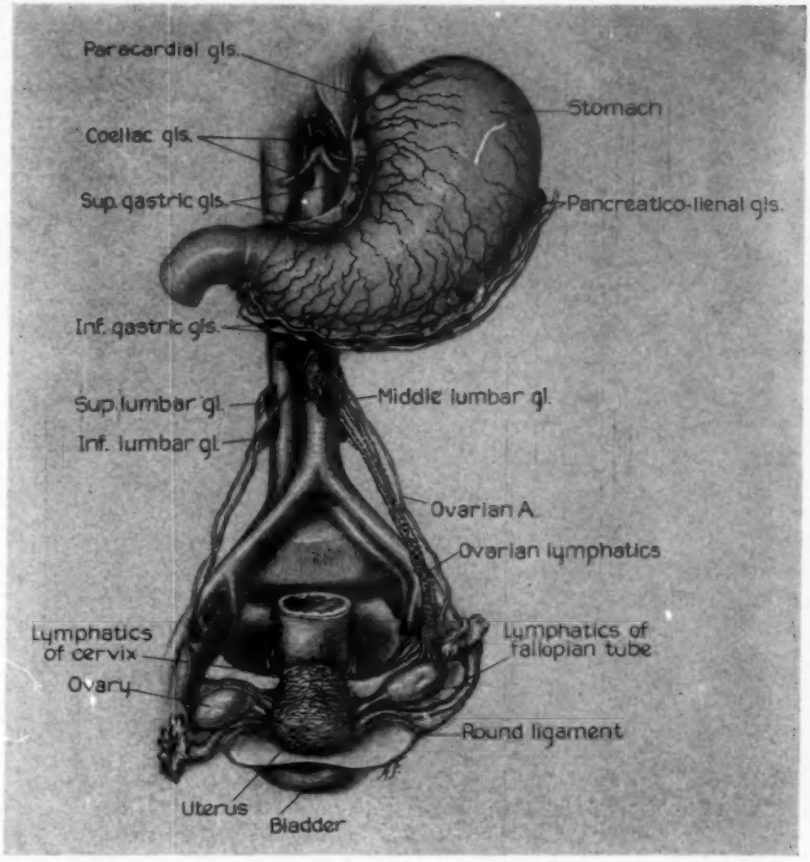


FIG. 6. Schematic drawing showing the lymphatics of the gastrointestinal tract and internal genitalia.

ovary by way of the lymph glands is "the most plausible," points out that: "Weight is added to this hypothesis in the shape of these secondary tumors, which, even when quite large, almost invariably conform to the original form of the ovary, as though the invasion were through the medulla and not through the cortex." Other characteristics of Krukenberg tumors that also suggest invasion of the ovary from within by way of the blood vessels or lymphatics, in addition to their characteristic form, are the smooth surface, and the fact that the tumors are bilateral and usually of approximately the same size. (Fig. 1.)

In 1936, S. Jarcho discussed lymphangitic carcinomatosis of the lungs and metastatic carcinoma of the bone marrow with thrombopenia and purpura, as manifestations of a distinct

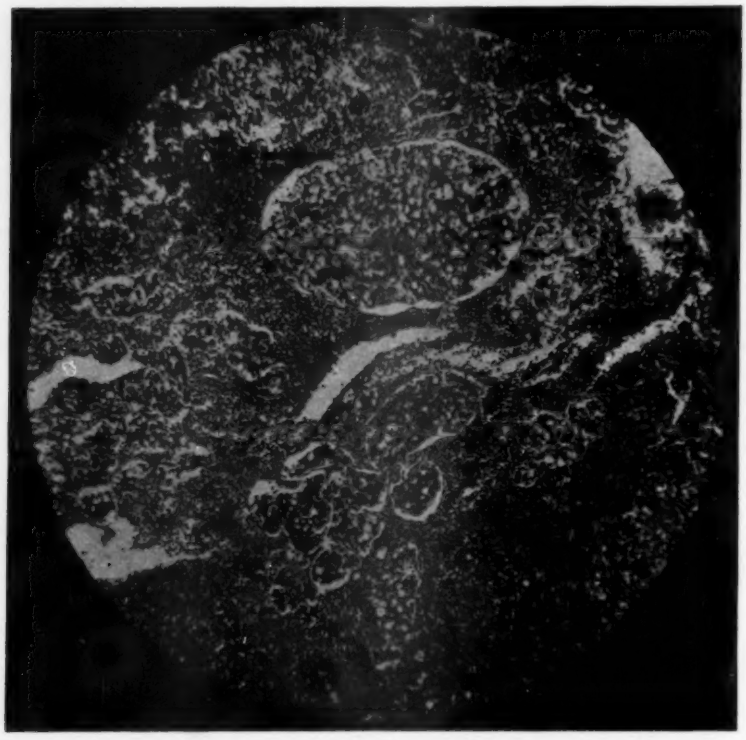
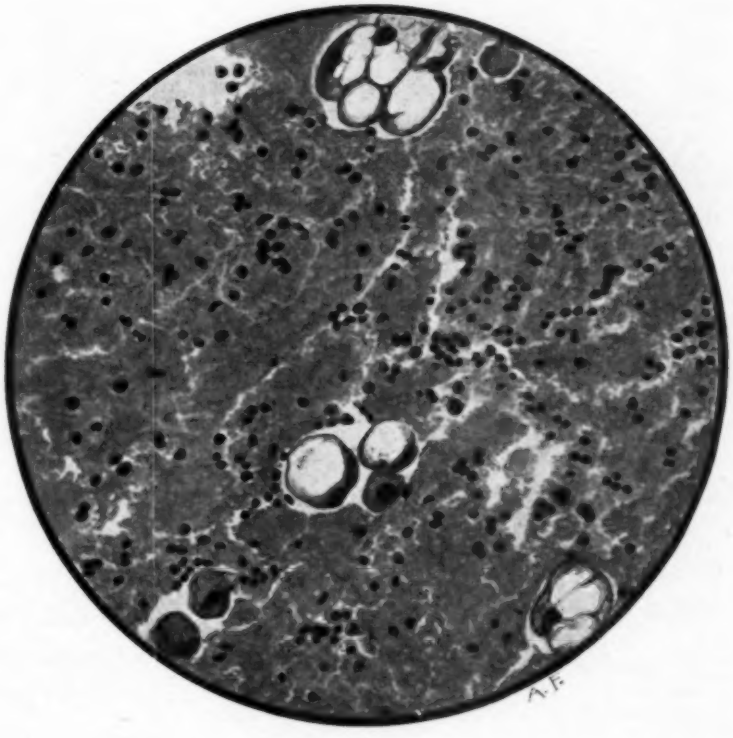


FIG. 7. Metastasis in pre-aortic lymph node. Note nests of signet-ring cells, also nests of solid cancer cells. (× 175.) Same as Figure 8 and Plate III.

variety of carcinoma metastasis. The term "diffusely infiltrating carcinoma" was given this type of lesion. In some of these cases of diffuse infiltrating carcinoma, the author notes that Krukenberg tumor of the ovaries is mentioned as an incidental finding with evidence that the metastasis to the ovaries occurred by way of the lymphatics.

As stated in my previous paper on Krukenberg tumor, it is of no moment whether the tumor cells grow along the lymphatic vessels, producing lymphangitis cancerosa, or are carried by the lymphatic stream; it is hardly possible for them to pass without affecting at least two sets of opposing lymph glands, especially since the travel of the cell is retrograde. For this reason we can hardly believe that gastric

III



IV

PLATE III. Metastasis in pre-aortic lymph node. The tumor cells are densely packed and occupy the upper two-thirds of the field. Note numerous signet-ring cells among masses of solid cancer cells. The lower third of the field contains largely uninvolved lymphoid tissue. (× 400.) Same as Figures 7 and 8.

PLATE IV. Ascitic fluid containing large signet-ring cells and "solid" cancer cells. (× 400.)

carcinoma could give rise to metastases in the internal genital organs without affecting the lymph glands.

In some of the reported cases of Krukenberg tumor of the

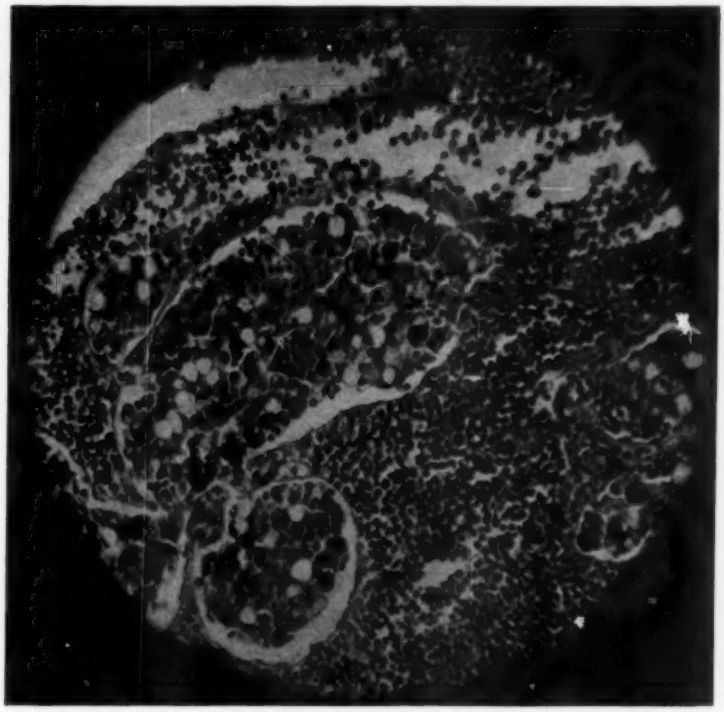


FIG. 8. Metastasis in pre-aortic lymph node. The tumor cells are arranged in nests. Numerous signet-ring forms are easily seen. (× 350.) Same as Figure 7 and Plate III.

ovary, the first symptoms were those of gastric carcinoma, and the ovarian tumor was discovered either at operation, or more frequently later, because of the development of pelvic symptoms at varying intervals after the primary operation. More often the pelvic symptoms develop first and dominate the clinical picture, and there is no clinical evidence to indicate that there is a primary tumor or where it is located. Even *x*-ray examination of the gastrointestinal tract may not reveal a small tumor in the stomach or intestines.

If unilateral or bilateral tumors of the ovary with the gross appearance of the Krukenberg tumor are found at operation, the gastrointestinal tract should be carefully explored to determine the site of the primary lesion. However, the primary tumor may be so small and inconspicuous, not invading the

external wall of the stomach, that, though carefully sought, it may easily escape detection. Even at autopsy such a growth may be overlooked unless the most scrupulous histologic examination is made.

Krukenberg tumors have certain clinical characteristics that should be noted. They tend to occur at an earlier age than other carcinomata of the ovary, primary or secondary. Bell and Datnow state that the average age of patients with malignant tumor of the ovary (excepting cystic teratoma and possibly sarcoma) "falls between 42 and 50 years."

In Krukenberg's five cases the age of the patients ranged from 25 to 43 years, and only one of them was over 40. This represents the more usual age limits for Krukenberg tumors fairly well. Vaptzaroff, who collected twenty-six cases of the Krukenberg neoplasm from the literature, found approximately two-thirds to occur in patients under 40.

In my seven cases previously reported, four patients were over 40 years of age, and three over 50; but in the three cases reported in this article only one patient was over 40. This would make 50 per cent of the ten cases over 40, a somewhat higher age incidence than is indicated by the statistics quoted above, but still lower than that given by Bell and Datnow for ovarian carcinoma in general.

A few cases have been reported in very young patients (under 20), and this is the more remarkable since carcinoma of any type is rare at this age, and carcinoma of the gastrointestinal tract, the usual site of the primary tumor of the Krukenberg type, is especially rare.

Marchand (1919) and Chapman (1920) each report a case in a girl 14 years of age. In both of these cases the enlargement of the abdomen due to the growth of the tumor was the primary symptom. In Marchand's case there was no evidence of a gastric or intestinal tumor and no autopsy was done. Marchand regarded the ovarian tumor as primary, especially because of the age of the patient, but this was not proved.

In Chapman's case, examination of the abdominal organs at operation showed "a growth the size of a dollar of definitely scirrhous carcinomatous appearance and feel on the lower edge of the anterior wall of the stomach, at the middle of

the greater curvature." This was considered to be the primary tumor.

Franssen and Kukin each report a case in a patient 18 years of age. In the former, the patient was operated on because of symptoms of ovarian tumor, but no primary tumor was found at operation. Twenty days later, however, symptoms of ileus developed, found to be due to adenocarcinoma of the large intestine.

In Kukin's case the patient had had some dyspeptic symptoms for two years, but developed distention of the abdomen and palpable tumor only three weeks before admission to the hospital. She died on the sixth day, and autopsy showed gastric carcinoma with ovarian metastases of the Krukenberg type.

Two cases at the age of 19 are reported, one by Krüger and one by Miner, both of which were regarded as primary in the ovary. In Miner's case the ovarian tumor was unilateral; the patient was well a year after its operative removal.

Cohn and Reel each report a case of Krukenberg tumor at the age of 21. In both of these cases the ovarian tumor was secondary—to carcinoma of the sigmoid in Cohn's case and to carcinoma of the stomach in Reel's case.

The Krukenberg lesion often grows to large size, the secondary ovarian growth being much larger than the primary tumor. Frankl reports a case in which the tumor grew to an enormous size which he describes as the size of two pregnant uteri in the later months. Schmid reports a similarly large Krukenberg tumor which he states was twice the size of an infant's head. In one of my cases and in one reported by Blair Bell, the tumor was the size of the fetal head. Very frequently the neoplasms are the size of a man's fist.

Krukenberg tumor may develop in pregnant women. This usually complicates the diagnosis and renders the prognosis even more unfavorable than usual. The pregnancy may terminate in abortion or miscarriage, or death of the fetus may necessitate removal of the uterus with the ovarian tumors.

In their series of cases Bell, Cohn and Frankl each report one case occurring in pregnancy. Burdsinsky, Schmid, Guiroy and Jakob, and more recently Puppel, Esau, Bud and Wendt

have each reported a case of Krukenberg tumor occurring in a pregnant patient. In these cases the patients died within a few days to a few months after the removal of the tumors, except

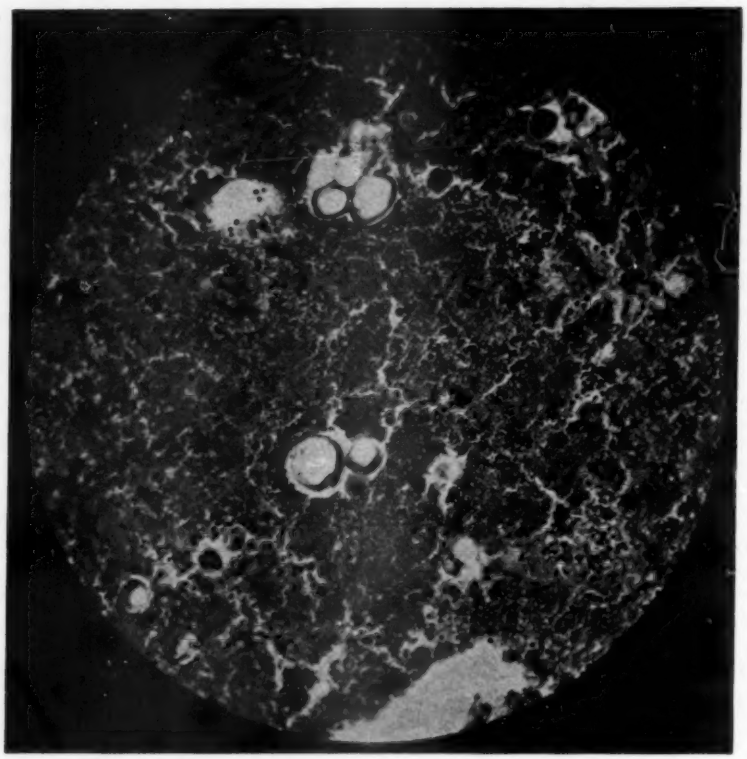


FIG. 9. Photomicrograph (× 350). Same as Plate IV.

in Esau's case in which the patient was well a year and a half before gastric symptoms developed, and an inoperable carcinoma of the stomach was found at an exploratory laparotomy.

As a rule Krukenberg tumors are freely movable, and adhesions rarely occur, at least in the earlier stages of their development. Incidentally it may be noted that this fact is a further argument against metastasis by direct extension. Another clinical characteristic of Krukenberg tumors is that they frequently cause ascites, sometimes of marked degree. This is the more interesting since metastases to the liver are rarely found in cases of Krukenberg tumor.

Willis, calling special attention to this fact, states: "Especially notable is the almost invariable escape of the liver in these cases; Krukenberg tumours of the ovaries accompanied by hepatic metastases are quite exceptional."

The frequent occurrence of ascites in Krukenberg tumor, occasionally accompanied by pleural effusion, is noted by many authors. In the case reported by Krukenberg in which a full clinical history is given, the presence of ascites and pleural effusion is noted. In four of my seven cases, previously reported, and in one of the three cases reported in this article, ascites was present; although in one of the former group it was not noted clinically, but was found only at autopsy.

Occasionally a diagnosis of Krukenberg tumor may be made from the examination of sections of ascitic fluid.

Gauthier-Villars states that if ascites is not demonstrable clinically in Krukenberg tumors it is "almost constantly found at operation." Ascites may be due to peritoneal metastases in some cases, but, on the other hand, it may occur without any demonstrable peritoneal implantation of cells, as Shaw, in particular, has noted. In his three cases with ascites, only two showed peritoneal metastases. In other cases the ascites may be attributed either to the obstruction of the lymphatics by cancer cells, or to the irritation of the peritoneum by the ovarian tumors.

Evidence presented by Hermann indicates that metastasis to the ovaries from gastrointestinal carcinoma occurs first, and that involvement of other pelvic organs, including tubes, uterus and bladder is secondary to ovarian involvement. In twelve cases of Krukenberg tumor of the ovary secondary to carcinoma of the gastrointestinal tract, he found the tubes involved in seven cases, the bladder in six of these cases, and the uterus in five cases.

In my seven cases reported in 1927, carcinomatous infiltration of the tubes had occurred in three. Such findings would also indicate that involvement does not generally take place by direct extension.

When a diagnosis of secondary ovarian carcinoma of the Krukenberg type is made in this way, I consider that radical operation is contraindicated. Lymph gland involvement from the primary tumor is so far advanced that radical removal is impossible. In other words, I believe that radical measures in these cases are useless, and never justified unless undertaken for the relief of pressure symptoms.

In 1931 Amreich reported a case of Krukenberg tumor (proven histologically) in which both the primary and secondary tumors had been radically removed in 1925 and the patient was living and well more than five years later.

In this case the primary tumor was in the ileocecal region; the ovarian metastasis was unilateral, involving the right ovary only. At operation a "typical ileocecal resection" was done with removal of a group of enlarged glands along the ascending colon. Sixteen days later the uterus with the adnexa on both sides was removed. The intestinal tumor was a mucoid adenocarcinoma; the ovarian tumor a typical Krukenberg neoplasm with numerous signet-ring cells. Microscopic examination of many sections from the tube and uterus showed no signs of carcinoma. These operations were performed in April 1925, and the patient was living and well in September 1930, when examined by Amreich, who found no signs of recurrence.

However, the fact that the process was unilateral and the uterus and tube were not involved, indicates that in all probability the neighboring lymphatics only were affected, which would explain the good result. Such a favorable outcome, however, is a rare exception—it may be the exception that proves the rule.

Although Comando advocates radical operation on both the primary and the secondary tumors in cases of Krukenberg tumor, if there is no general metastasis, I note that in his two cases in which this was done—the gastric cancer being removed first and the ovarian tumors some months later when symptoms developed—the longest period of freedom from symptoms was eighteen months after the second operation, and the patient then "went downhill very rapidly with a recurrent carcinomatosis of the abdominal organs." In the second case the survival period was only about six months. So that in these cases, in spite of two radical operations, the further spread of the disease could not be prevented.

Of the five cases of Krukenberg tumor reported from the Mayo Clinic by Masson, subtotal or total hysterectomy with removal of both tubes and ovaries was done in one case, together with operation on the gastric carcinoma in all three

cases. In two cases no radical operation was attempted. All the patients died from advance of the disease.

In a discussion of this paper, Dieckmann of Chicago stated that if a diagnosis of Krukenberg tumor has been made, radical operation is contraindicated.

In my seven cases reported in 1927, the tumor was found at autopsy in four cases, while in three a double salpingo-oöphorectomy was done as a palliative measure.

In Simecek's case, cited above, widespread metastasis had occurred; the primary tumor was small and superficial, involving only the mucosa and submucosa, and not penetrating into the muscle of the gastric wall. Such findings indicate clearly that extensive metastasis may occur with a small primary tumor that would be difficult to detect even at operation. As I have repeatedly stated, cases such as these serve to establish my conviction that radical operation is not indicated in Krukenberg tumor of the ovaries.

From the available statistics and case reports it appears that the Krukenberg tumor must be a relatively rare lesion.

In 1934 Martin reported that in 107 cases of malignant ovarian tumor operated on at the Gynecologic Clinic of the University of Leipzig, there were five Krukenberg tumors. At the Institute of Pathologic Anatomy in Strasbourg, ten Krukenberg tumors were found in 500 specimens of ovarian tumor (Géry and Adrian).

At St. Bartholomew's Hospital in London, Shaw reported that in a series of 300 cases of ovarian tumors, there were seventy-seven carcinomata, and of these three were Krukenberg tumors. In 1927, Rohdenberg reported that in 500 ovarian tumors coming to the pathologic laboratory of the Lenox Hill Hospital (New York), there were sixty-four carcinomata; three of these were Krukenberg tumors. A recent report by Bernstein from the Mt. Sinai Hospital (New York) shows that in a series of 1,101 cases of ovarian tumor operated from 1924 to 1925, 191 were malignant tumors and six of these were Krukenberg tumors. Of 101 ovarian tumors operated at the Sydenham Hospital (New York), thirty-three were malignant and three of these were Krukenberg tumors.

The case reports for the three cases from the Sydenham Hospital follow. None of these cases came under my personal observation, and the data presented are from the hospital records. No information is available about the subsequent history of any of the cases.

CASE I. M. B., married woman, age 44, admitted to the hospital June 30, 1929.

Complaint. Pain in abdomen.

Present Illness. One month prior to admission, the patient was seized with sharp generalized pain in the abdomen unrelated to meals. There was no nausea, vomiting, constipation or melena. Pain lasted for one week and did not recur. The patient had anorexia and had lost 15 pounds. No malaise or weakness was reported.

Past History. A uterine tumor and cysts had been removed eight years previously.

Physical Examination. The patient was well developed and seemed well nourished with no apparent pain. In the left lower quadrant of the abdomen there was a hard mass as large as a baseball.

Operation. July 1, 1929, an exploratory operation disclosed the presence of generalized carcinomatosis. Blocks of tissue were removed.

Microscopic. Sections showed a very cellular tissue, the greater part of the cells being very large mucoid cells with peripherally placed nuclei—perfect signet-ring cells.

Pathologic Diagnosis. Krukenberg tumor of ovary (metastatic from stomach or intestine).

Summary. Woman of 44, married, admitted with a history of an attack of abdominal pain of one week's duration one month ago, and a loss of 15 pounds in weight since that time. Examination showed a large tumor in the lower abdomen. Operation showed diffuse carcinomatosis of the abdomen and a large ovary the size of a baseball. Biopsy specimen reported Krukenberg tumor of ovary. Patient discharged, condition unchanged; wound healed by primary union. (See Plate 1 and Figs. 2 and 3.)

CASE II. H. P., housewife, age 35, admitted to the hospital January 16, 1928.

Complaint. Backache, vaginal bleeding, vaginal discharge.

Menstrual History. Menses at 17, occurring every twenty-eight days, three to four days' duration. There had been no menorrhagia or metrorrhagia until present illness.

Marital History. The patient had been married twelve years. She reported no abortions, but had had five full-term pregnancies, with her oldest child 11 years and her youngest 1 year of age. Labor and puerperium were normal.

Present Illness. For the past year the patient had had metrorrhagia, especially after intercourse or exercise. During the same period she had

also had leucorrhea. For about eight weeks she had severe backache, with radiation down the thigh and leg. The pain has been unbearable at night.

Physical Examination. The patient was a white woman, 35 years of age, lying quietly in bed in no apparent distress. Her nutrition was good; there was no pallor. Pelvic examination was unsatisfactory.

Operation. January 17, 1928, exploratory operation was done with a midline incision. The tubes were found to be beefy red with spots of white on outside, suggestive of tubercles. The ovaries were large and cystic. Tubes and ovaries of both sides were removed, and also the appendix. The abdomen was closed in layers.

Pathologic Report. Nature of specimen: tubes, ovaries, appendix. Diagnosis: Metastatic carcinoma of the ovary and tubes (Krukenberg tumor).

Summary. A woman, aged 35, had leucorrhea and metrorrhagia for one year and backache for eight weeks. She was found to have very large ovaries which proved to be Krukenberg tumors. No mention was made on chart as to whether the rest of the abdominal cavity was explored. Specimen was not available for reëxamination; hence the diagnosis could not be reviewed by the present author.

CASE III. C. G., housewife, aged 33, was admitted to the hospital January 13, 1929.

Chief Complaints. There had been vomiting—two years; abdominal enlargement—four months; abdominal pain followed by heartburn one to two hours after meals—three weeks.

Menstrual History. Menses began at 13 years, and occurred every twenty-eight days, two or three days' duration.

Marital History. Patient was married nine years before and had had three pregnancies: the first a forceps delivery, the second a normal delivery, and the third aborted.

Present Illness. About two years before, the patient noticed that about two or three times a week approximately ten minutes after breakfast she felt like bringing up something, but she rarely actually vomited up the material. About five months ago she noticed that after a very rich meal she vomited up undigested food. At times this occurred two or three hours after the meal. She noticed that taking a fraction of the usual quantity of food made her feel filled up. Abdominal enlargement had been noted for past four months. About three weeks ago she began to have an upper abdominal pain which gave her heartburn one to two hours after meals. During the past five months patient lost 20–22 pounds.

Physical Examination. She was a white adult, well-developed female, not acutely ill. The abdomen appeared like that of a seven months' pregnancy. Hard parts could be felt over the tumor mass which reminded one of the small parts of a fetus. The hard masses felt larger and more resistant than the small parts in a seven months' pregnancy. Liver, spleen and kidneys were not palpable. There was no tenderness, no

rigidity. Umbilicus elevated. Shifting dulness was elicited in the flanks. Fluid wave was present.

Operation. January 14, 1929. A median abdominal incision was made from pubis to umbilicus. A large quantity of fluid, straw-colored, was aspirated with suction apparatus. A papillary cyst, most probably carcinomatous in nature, involving both ovaries, was removed, and a large piece of omentum-bearing tumor was excised.

Pathologic Report. Specimen consisted of two cystic ovaries and a piece of omentum. The omentum measured 6 × 7 × 1 cm., was distinctly hard and infiltrated with a grayish substance. The larger one of the ovaries (right) measured 15 × 13 × 4 cm. Two-thirds of the substance of the two large cysts within this ovary contained gelatinous material with some hair in it. The linings of these cysts were very thin. There were a few old corpora lutea in the solid portion of this ovary. The other ovary (left) measured 5 × 4 × 3 cm. The surface was distinctly irregular. On section, one quarter of the ovary was occupied by a cyst which contained a large amount of hair. There was another smaller cyst about 3.4 cm. in diameter which contained grayish mucoid material.

Microscopic. The omentum showed a typical metastatic adenocarcinomatous picture. Sections from the right ovary were clearly indicative of metastatic colloid carcinoma. Sections made from the left ovarian tumor in which a typical dermoid cyst had been found, showed a picture of a fibrous sarcoma in which, however, a few carcinomatous areas were seen and what appeared to be sarcomatous tissue was merely edematous reaction; the carcinomatous areas were composed of large pale cells, some of which had a typical signet-ring appearance.

Pathologic Diagnosis. Krukenberg tumor of ovary (bilateral). Metastatic carcinoma of omentum (colloid), metastatic from gastrointestinal tract.

Summary. Patient complained of weakness, abdominal enlargement, and abdominal pain. On examination, masses were felt in the abdomen. Operation revealed fluid in the abdomen, bilateral tumors of ovary and metastatic tumor of omentum. Pathologic report—Dermoid cysts and Krukenberg tumors of both ovaries. During convalescence patient developed right-side parotid inflammation which after several days began to subside. (See Plate 1 and Figs. 2, 3 and 10.)

In reporting a case of Krukenberg tumor in September 1937, Phillips states that "a fair estimate" of the number of Krukenberg tumors reported today is "about 125." But in a review of the literature I have found approximately 303 tumors of this type reported, including Krukenberg's five cases. Most of these have been reported singly or in small series, and in considerable detail, but others included in this number are only mentioned in general discussions of the subject. Thus

Mayer, in his contribution to Halban-Seitz, states that he has seen eleven cases of Krukenberg tumor, and Ewing notes in his book that he has seen six cases, but these are not described.

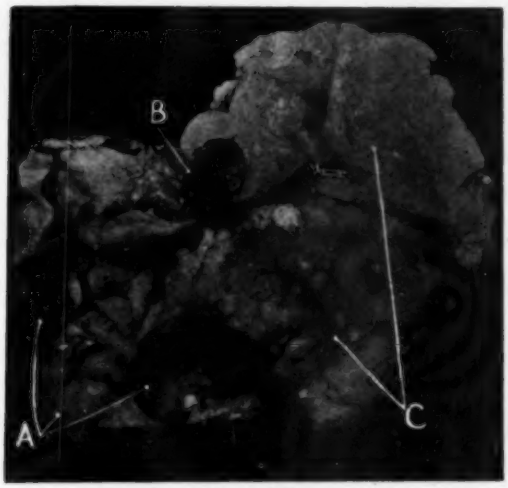


FIG. 10. Cross section of larger ovary. A, two cysts within the ovary contain gelatinous material. The linings of these cysts are very thin. B, clump of tangled hair. C, microscopic sections of the solid portion of the ovary are typical of Krukenberg tumor. See also Plate 1 and Figures 2 and 3, which are sections from this tumor.

Gleize-Rambal and Robert are credited with fifteen cases, although they report but one in detail. They state, however, that they have seen fifteen cases of Krukenberg tumor, three of which showed a partially adenocarcinomatous structure, to which type the case reported belongs.

In addition, there are seventeen other cases reported in which the nature of the tumor is in doubt. However, from their description, these might properly be classed as Krukenberg tumors. These statistics indicate that the Krukenberg tumor may occur more frequently than has been supposed. It is my belief that with a better understanding of the true nature of these neoplasms—to which I hope this article may have contributed—the number of cases reported in the future will increase.

CONCLUSIONS

Krukenberg tumors of the ovary are malignant tumors, typically secondary to carcinoma of the gastrointestinal tract

or cancer of the breast. They are characterized by the fact that the ovary is symmetrically enlarged, but retains its normal form with smooth surface. They rarely form adhesions, especially in the early cases.

At present we cannot exclude the possibility that in occasional rare instances the Krukenberg tumor may be primary in the ovary.

The so-called Krukenberg cells—signet-ring cells—are not invariably present.

The Krukenberg tumor occurs at an earlier age period than other types of carcinoma of the ovary; a few cases have been reported in girls under twenty.

Ascites is one of the characteristic clinical symptoms; occasionally a diagnosis of Krukenberg tumor may be made from examination of sections of ascitic fluid.

Because these tumors are secondary to gastrointestinal tumors that are generally believed to metastasize by way of the lymph glands, cure by radical removal of the ovarian tumor is impossible. Even operative removal of the primary growth does not prevent further metastasis.

REFERENCES

AMANN, J. A. Ueber sekundäre Ovarialtumoren. *München. med. Wchnschr.*, 52: 2414, 1905.

Idem. Ueber metastatische Ovarialtumoren. *Verhandl. d. deutsch. Gesellsch. f. Gynäk.*, 2: 346, 1906.

AMREICH, I. Dauernd geheiltes metastatisches Ovarialkarzinom. *Wien. klin. Wchnschr.*, 44: 165, 1931.

ANDREWS, C. J. Krukenberg tumor of ovary; report of 3 cases. *South. M. J.*, 27: 597, 1934.

ARMSTRONG, M. V., and WOLFE, S. A. Krukenberg tumor of ovary. *Am. J. Obst. & Gynec.*, 27: 906, 1934.

BELL, W. B. Three cases of Krukenberg tumor. *Brit. M. J.*, 1: 798, 1927.

Idem. The Principles of Gynaecology. 4th Ed., p. 588. London, 1934. Bailliere.

BELL, W. B., and DATNOW, M. M. Ovarian neoplasms; some points in their pathology, clinical features and treatment. *Am. J. Cancer*, 16: 1 (Jan.); 439 (May) 1932.

BERNSTEIN, P. Tumors of ovary; study of 1,101 cases of operations for ovarian tumor. *Am. J. Obst. & Gynec.*, 32: 1023, 1936.

VON BUD, G. Case of Krukenberg tumor, acne papulosa, preëclampsia and focal infection in pregnant woman. *Orvosi hetil.*, 79: 146, 1935.

BURDSINSKY, T. A. Eine Ovariotomie während der Schwangerschaft wegen einer Krukenberg'schen Geschwulst und nachfolgender Kaiserschnitt wegen Metastase dieser Geschwulst in der Gebärmutter. *Zentralbl. f. Gynäk.*, 32: 410, 1908.

CHAPMAN, T. L. Krukenberg tumor. *Surg., Gynec. & Obst.*, 31: 58, 1920.

COHN, F. Über metastatisches Ovarialkarzinom. *Monatschr. f. Geburtsh. u. Gynäk.*, 31: 333, 1910.

COMANDO, H. N. Krukenberg tumor of ovary. *Am. J. Surg.*, 26: 575, 1934.

DIECKMANN, W. J. Discussion of Masson's paper on Krukenberg tumors of ovary. *Am. J. Obst. & Gynec.*, 27: 825, 1934.

ENZER, N. Krukenberg tumors of ovary. *Ann. Surg.*, 92: 149, 1930.

ESAU. Krukenbergtumoren in der Schwangerschaft. Nachtrag zu der Arbeit von Dr. Puppel. *Zentralbl. f. Gynäk.*, 57: 1167, 1933.

EWING, JAMES. Neoplastic Diseases (Fibrosarcoma Mucocellulare Carcinomatodes—Krukenberg). 3rd Ed., p. 644. Phila., 1928. W. B. Saunders Company.

FALLAS, R. Krukenberg tumor of ovary with report of two cases. *Surg., Gynec. & Obst.*, 49: 638, 1929.

FRANKL, O. Pathologische Anatomie und Histologie der weiblichen Genitalorgane—in Kurzgefasster Handbuch der gesamten Frauenheilkunde. Band II., p. 212. Leipzig, 1914. W. Liepmann.

FRANKL, O. Beiträge zur Pathologie und Klinik des Ovarialkarzinoms. *Arch. f. Gynäk.*, 113: 29, 1920.

Idem. Über Krukenbergtumoren in der Schwangerschaft, *Zentralbl. f. Gynäk.*, 57: 788, 1933.

Idem. Personal communication.

FRANSSEN, R. Un pseudo-oöphoroma de l'ovaire, métastase d'un cancer intestinal. *Ann. d'anat. path.*, 7: 1053, 1930.

GAUTHIER-VILLARS, P. Étude des métastases ovariennes des épithéliomas digestifs. *Ann. d'anat. path.*, 5: 1, 1928.

GÉRY, L., and ADRIAN, J. Étude statistique des tumeurs de l'ovaire, (résultats de 500 examens histologiques). *Bull. Soc. d'obst. et de gynéc.*, 24: 310, 1935.

GLEIZE-RAMBAL, L., and ROBERT, J. P. Sur la présence dans les tumeurs ovariennes du type Krukenberg de formations glandulaire d'origine gastrique. *Compt. rend. Soc. de biol.*, 92: 708, 1925.

GUIROY, A. J., and JAKOB, A. Tumeur de Krukenberg et grossesse. *Bull. Soc. d'obst. et de gynéc.*, 17: 535, 1928.

HERMANN, H. B. Metastatic tumors of urinary bladder originating from carcinomata of gastrointestinal tract. *J. Urol.*, 22: 257, 1929.

HUNDLEY, J. M., JR. Krukenberg tumors and other secondary overian carcinomas. *South M. J.*, 24: 579, 1931.

JARCHO, J. Krukenberg tumors and their practical problems. *Am. J. Obst. & Gynec.*, 13: 288, 1927.

JARCHO, S. Diffusely infiltrative carcinoma; hitherto undescribed correlation of several varieties of tumor metastasis. *Arch. Path.*, 22: 674, 1936.

KRÜGER. Krukenbergsche Ovarialtumoren. *München. med. Wchnschr.*, 56: 2606, 1909.

KRUKENBERG, F. Ueber das Fibrosarcome ovarii mucocellulare (carcinomatodes). *Arch. f. Gynäk.*, 50: 287, 1896.

KUKIN, N. N. Cancer of stomach in children with metastases in ovaries of Krukenberg type. *Sovet. kbir.* (#6), 5: 291, 1933.

MAJOR, R. H. A study of the Krukenberg tumor. *Surg., Gynec. & Obst.*, 27: 195, 1918.

MARCHAND, F. Über die sog. Krukenbergschen Ovarialtumoren. *Monatschr. f. Geburtsch. u. Gynäk.*, 50: 117, 1919.

MARTIN, W. Beitrag zur Prognose der malignen Ovarialtumoren. Leipzig Thesis, 1934.

MASSON, J. C. Krukenberg tumors of ovary. *Am. J. Obst. & Gynec.*, 27: 825, 1934.

MATTERS, R. F. Ovarian malignancy, with special reference to Krukenberg tumours. *M. J. Australia*, 1: 181, 1926.

MAYER, A. Klinik der Ovarialtumoren in Halban-Seitz: Biologie und Pathologie des Weibes. Band V, Teil 2, (4) Krukenberg-Tumoren, p. 846, 1926.

MINER, D. Primary Krukenberg carcinoma of ovary. *S. Clin. N. Amer.* 6: 1645, 1926.

NOVAK, E., and GRAY, L. A. Krukenberg tumors of the ovary. *Surg., Gynec. & Obst.*, 66: 157, 1938.

PALAZZO, R., and TACHELLA COSTA, A. O. A propósito de los tumores de Krukenberg; metástasis cutánea de un carcinoma gástrico con las caractérísticas células en sortija. *Rev. sud-am. de endocrinol.*, 19: 248, 1936.

PHILLIPS, C. Abdominal carcinomatosis, Krukenberg tumor type, with case report. *South. M. J.*, 30: 873, 1937.

PUPPEL, E. Über Krukenbergtumoren in der Schwangerschaft. *Zentralbl. f. Gynäk.*, 57: 49, 1933.

REEL, P. J. Krukenberg cancer of ovary. *Interstate M. J.*, 24: 520, 1917.

Idem. Krukenberg tumor of ovary. *Ann. Surg.*, 73: 481, 1921.

ROHDENBURG, G. L. An analysis of 500 tumors of the ovary. *J. Lab. & Clin. Med.*, 12: 211, 1926–1927.

RUNYEON, F. G. Krukenberg tumor; report of case with rectal involvement, producing stricture. *J. A. M. A.*, 103: 1199, 1934.

SCHMID, H. H. Magen carcinom und Graviditat. *Arch. f. Gynäk.*, 121: 168, 1924.

SHAW, W. Krukenberg tumours of the ovaries. *Proc. Roy. Soc. Med.* (Sect. Obst. & Gynaec.), 19: 493, 1926.

Idem. Krukenberg tumours of the ovary. *J. Obst. & Gynaec. Brit. Emp.*, 33: 256, 1926.

Idem. Ovarian carcinomata. *J. Obst. & Gynaec. Brit. Emp.*, 39: 816, 1932.

SIMECEK, A. Diagnosis of Krukenberg tumor. *Am. J. Cancer*, 31: 21, 1937.

STERNBERG, C. Ein Fall von multiplem Endotheliom ("Krukenberg'schen Tumor") des Knochenmarks. *Centralbl. f. allg. Path. u. Path. anat.*, 12: 625, 1901.

VAPTZAROFF, Y. D. Contribution à l'étude des "Tumeurs de Krükenberg." Bordeaux Thesis, 1934.

WALTHARD, M. Zur Aetiologie der Ovarialadenome. *Ztschr. f. Geburtsh. u. Gynäk.*, 49: 233, 1903.

WENDT, F. Krukenberg tumor complicating pregnancy. *Svenska läk.-tidning.*, 32: 51, 1935.

WILLIS, R. A. The Spread of Tumours in the Human Body. London, 1934. J. & A. Churchill.

Collective acknowledgement is made to the authors of many important works consulted in preparation of this paper whose names are not included in the bibliography. This is due entirely to lack of space.

I wish also to express appreciation to Dr. A. A. Eisenberg for his kindness in placing certain microscopic preparations at my disposal.

AUTHOR INDEX TO VOLUME XLI

Adams, Lou E., 22
Akcakoyunlu, Ilhami, 519
Allen, Frederick M., 192
Antony, Arthur T., 453
Arnheim, Ernest E., 45
Arnold, Lawrence E., 498

Bellin, Harold, 494
Berry, C. H., 393
Bettmann, Ernst, 201
Birnberg, Charles H., 39
Bisgard, J. Dewey, 525
Bowen, Arthur, 281
Bower, John O., 369
Branch, Charles D., 233
Brown, Merle J., 238

Carabba, Victor, 480
Carroll, George F., 87
Charache, Herman, 275
Connell, F. Gregory, 255
Cresci, Joseph, 216
Crile, George, Jr., 22

Daily, William T., 213
Dannreuther, Walter T., 373
Danzis, Max, 304
Davidson, Arthur J., 115
Decker, Albert, 449
Dunn, Cecil G., 268

Eckelberry, Niel E., 51
Eliason, E. L., 419

Fallis, Lawrence S., 427
Ferguson, L. K., 57
Fradkin, William Z., 128
Friedman, Lewis J., 310
Friedman, Milton, 304

Glass, Morris, 216
Glenn, Frank, 259
Goldstein, Albert E., 96
Gordon, Charles A., 187
Green, J. Leighton, 307
Greenblatt, Robert B., 384

Haines, Charles, 118
Hall, W. E. B., 458
Hamblen, E. C., 35
Handelsman, Milton B., 328
Hawes, G. Aubrey, 509
Hayes, William M., 123
Hedrick, Donald W., 320
Hendon, G. A., 119
Horwitz, M. Thomas, 115

Isaacs, Harry E., 298
Israel, George I., 327

Jarcho, Julius, 537

Keen, Morris Robert, 228
Kellogg, William A., 135
Kross, Isidor, 462
Kurzrok, Lawrence, 39

Lawrence, W. H., 393
Lawson, Henry Carnie, 70
Levi, Leo M., 325
Levinson, Louis, J., 304
Livingston, Seymour, 39
Livingston, S. K., 49

Mazner, Mary, 103
McLaughlin, Charles W., 512
Miller, J. K., 474
Montgomery, Charles F., 320
Morris, Kenneth A., 108
Morrison, Gordon Monroe, 526
Mowery, W. E., 42
Munger, Arbor D., 220
Murray, Samuel D., 341

Ochsner, Alton, 341
Oginz, Philip, 70

Pack, George T., 77
Peterson, Leonard T., 293
Peterson, Thomas H., 405
Preston, Alexander, 112

Regan, James R., 501
Ritter, Saul Alfred, 486
Robertson, Hugh, 3

Salvin, Arthur A., 288
Sanderson, Everett S., 384
Schumann, Edward A., 527
Schwartz, Albert M., 298
Searles, Paul W., 399
Severance, Robert, 127
Sharpe, John C., 512
Sheinfeld, William, 315
Shlimbaum, Sol, 228
Silverstone, Sidney M., 77
Slater, Charles, 310
Sloat, J. I., 293
Slocum, Morris A., 464
Smith, Frederick L., 67
Sparrow, Thomas D., 92

Texon, Meyer, 449
Thigpen, G. M., 419
Totten, H. P., 29
Tractenberg, I., 301
Turino, Thomas R., 453

Varner, H. H., 307

Warshaw, David, 437
Watt, James H., 272
Webb, George, 315
Whitman, Royal, 129
Wise, Robert A., 412
Wright, Louis T., 103

Zollinger, Robert, 233

SUBJECT INDEX TO VOLUME XLI

(Bo.B.) = Bookshelf Browsing; (E.) = Editorial

Abdomen, acute
  cardiovascular disorders and, 346
  cerebrospinal lesions and, 358
  diagnostic pitfalls, 341
  endocrine and allergic conditions and, 361
  genitourinary conditions and, 351
  inflammatory conditions, 345
  muscular lesions and, 360
  respiratory conditions and, 349
  systemic conditions and, 354
Abscess, pararectal and ischiorectal, electrothermy in, 443
Alkyl-dimethyl-benzyl ammonium chloride, as antiseptic, 268
Allantoin, clinical results with, 49
Ambulatory patient
  skin graft in, 67
  surgery in, 57
Ambulatory surgery, 57
American orthopedic surgery, evolution of (Bo.B.), 129
Amputation, in crushing leg injuries, slough following, 320
Anesthesia
  in ambulatory surgery, 57
  in thyroidectomy, 22
Antiseptics, comparative study, 268
Anus
  fissure of, electrothermy in, 442
  fistula of, electrothermy in, 443
  papillae of, instrument for removal, 327
Appendicitis
  perforated, drainage in, 255
    peritonitis complicating, management (E.), 369
  intravesical, fulguration of, bladder rupture following, 96
Arm, fractures of, rotary Thomas splint for, 123
Asphyxia, local, tourniquet and, 192
Astragalus, fracture of, 118

Barbed splint, in shoulder joint therapy, 201
Benzochrome, as urinary antiseptic, 449
Bladder
  prolapse of, new surgical procedure in, 42
  rupture of, following fulguration, 96
Blood
  diastase, in diagnosis of common duct stone, 233
  effect of ether anesthesia on, 399
  effect of sodium amytal anesthesia on, 399
Book Reviews:
  A Method of Anatomy, Descriptive and Deductive (Grant), 134
  Bile, Its Toxicity and Relation to Disease (Horrall), 336
  Colon as a Health Regulator—From a Surgeon's Point of View (Gray), 340
  Diary of a Surgeon in the Year 1751–1752 (Knyveton), 337
  Emergency Surgery (Bailey), 337
  Genital Abnormalities, Hermaphroditism and Related Adrenal Diseases (Young), 133
  Life of Chevalier Jackson (Jackson), 336
  Pediatric Surgery (Brenner), 337
  Physiological Basis of Medical Practice (Best and Taylor), 339
  Pituitary Gland (Timme, et al., Ed.), 535
  Postmortem Examination (Farber), 339
  Practice of Urology (Herman), 338
Book Reviews:
  Practitoners Library of Medicine and Surgery. Vol. XI. Eye, Ear, Nose and Throat, 534
  Some Fundamental Aspects of the Cancer Problem (Ward, Ed.), 339
  Sulfanilamide Therapy of Bacterial Infections (Mellon, Gross and Cooper), 536
  Surgery of the Sympathetic Nervous System (Gask and Ross), 338
  Surgical Treatment of Hypertension (Crile), 535
  Thirteen Horizontal Sections of the Thorax (Hovelacque, Monod and Evrard), 133
Brain disease, gastric ulcer and, 474
Breasts
  relation to endocrines, 39
  soft tissue radiography of, 310
Bubo, venereal, differential diagnosis, chancroid bacillary antigen in, 384

Calculus
  of common duct, blood diastase and, 233
  of ureter, rupture of kidney in, 288
Cancer
  developing on scars, 304
  of right and left colon, 281
  of urinary tract, treatment with supervoltage *x*-ray, 220
Cardiovascular conditions, acute abdomen and, 346
Carotid body, tumor of, 103
Cast material, new, 405
Castex, 405
Catheter, hemostatic, 127
Cerebrospinal lesions, acute abdomen and, 358
Chancroid bacillary antigen, in differential diagnosis of venereal bubo, 384
Cholecystitis
  acute, treatment, 29
  chronic non-calculous, 283
Chorionepithelioma, primary, of tube, 301
Chylous mesenteric cyst, marsupialization in, 464
Colon
  non-specific granuloma of, 112
  right and left, cancer of, 281
Colostomy, bag for, 325
Common duct, calculi, blood diastase and, 233
Cryptorchidism, torsion of cord in, 307
Cyst
  chylous mesenteric, treatment by marsupialization, 464
  twisted, of ovary, in three year old child, 298

Deaths, maternal, prevention of (E.), 187
Diastase, of blood, in common duct stone, 233
Dislocation, recurrent, of radio-ulnar articulation, 115
Drainage, in perforated appendicitis, 255
Dressing, simplified, for scalp, 128

Ectopic pregnancy, intra-uterine simultaneous with, 293
Editorials:
  Interns and residents, 1
  Prevention of maternal deaths as a medical problem, 187
  Rhythmic surgery, 371
  Surgical staff and management of spreading peritonitis complicating acute perforative appendicitis, 369
Electric current, high frequency, in hemorrhoidectomy, 45
Electrothermy, in rectal surgery, 437

Embolism, pulmonary, 3
Endocrines, breasts and, 39
Ether, effect on blood, 399
Eventration, postoperative, 494
Evisceration, experimental study, 462

Fallopian tube, primary chorionepithelioma of, 301
Fascia, suture of, atraumatic needle for, 525
Fissure-in-ano, electrothermy in, 442
Fistula-in-ano, electrothermy in, 443
Fistula, vesico-intestinal, 135
Fractures
  new cast material for, 405
  of arm, rotary Thomas splint for, 123
  of astragalus, 118
  of radius and ulna, dressing for, 480
Fulguration, of intravesical appendix, causing bladder rupture, 96

Galen, schools of medicine and (Bo.B.), 328
Gall-bladder
  acute inflammation, treatment, 29
  non-calculous chronic disease, 238
Gangrene, postoperative, of skin, 87
Gastrointestinal conditions, acute abdomen and, 356
Gaucher's disease, splenectomy in, 77
Genitourinary conditions, acute abdomen and, 351
Germicides, comparative study, 268
Goiter, in surgical practice, 259
Gonadotropic principles, in ovulatory failure, 35
Granuloma, non-specific, of colon, 112
Gynecology, contributions of New York to (Bo.B.), 527

Hand, trauma of, relation to occupation, 51
Head, injuries to, 272
Heart
  disease, in pregnancy, obstetrical aspects, 453
  penetrating wounds, 108
Hemangioma, of spleen, 519
Hemorrhoidectomy, with high frequency electric current, 45, 437
Hemostatic catheter, 127
Hernias, ribbon-gut repair of, 509
Hydropyonephrosis, rupture of kidney in, 288
Hysterectomy, supravaginal, 373

Infections, treatment with superheated antiseptic vapor, 119
Inflammation, in acute abdomen, 345
Internships (E.), 1
Intestine
  obstruction of, double lumen tube in, 412
    following Webster-Baldy operation, 498
  small, neuroblastoma of, 486
Intussusception, in adult, 315

Jelly, surgical, containing maggot active principle, 49

Kidney, spontaneous rupture, 288
Krukenberg tumor, of ovary, 537

Legs, crushing injuries, postoperative slough following amputation, 320
Leucoplakia, tube pedicle skin graft in, 92
Lung, embolism, clinical study, 3

Maggot active principle, surgical jelly containing, 49
Mammography, soft tissue technique, 310
Marsupialization, in treatment of chylous mesenteric cyst, 464
Medicine, schools of, in time of Galen (Bo.B.), 328
Miller-Abbott double lumen tube, in intestinal obstruction, 412
Mothers, deaths of, prevention (E.), 187
Muscular system, acute abdomen and, 360

Needle, atraumatic, for fascia suture, 525
Neuritis, ulnar, delayed, surgical treatment, 501
Neuroblastoma, of small intestine, 486
Neurogenic sarcoma, 275
New York, contributions of, to obstetrics and gynecology, 527

Obstetrics, contributions of New York to (Bo.B.), 527
Obstetrics, heart disease and, 453
Obstruction, intestinal
  double lumen tube in, 412
  following Webster-Baldy operation, 498
Occupation, trauma of hands and, 51
Operating room, set up for, 393
Operations, types of, in vesico-intestinal fistula, 161
Orthopedic surgery, American, evolution of (Bo.B.), 129
Ovary
  Krukenberg tumor of, 537
  twisted cyst of, in three-year old child, 298
Ovulation, failure of
  pituitary and, 35
  treatment with pituitary principles, 35
  treatment with pituitary-like principles, 35

Papillatome, 327
Pelvis, tuberculosis of, 216
Penis, thrombophlebitis of, 228
Peptic ulcer
  perforation in, 427
    effect on results, 419
Perforation
  in peptic ulcer, 427
    effect on results, 419
Peritonitis, complicating perforative appendicitis, management of (E.), 369
Pinch grafts, carcinoma of scars and, 304
Pituitary, in ovulatory failure, 35
Pituitary-like principles, in ovulatory failure, 35
Placenta accreta, 70
Pregnancy
  heart disease in, obstetrical aspects, 453
  simultaneous intra- and extra-uterine, 293
  syphilis in, 213
Prolapse, of uterus and bladder, surgical procedure in, 42
Pulmonary embolism, clinical study, 3

Radio-ulnar articulation, recurrent dislocation, 115
Radius, fractures of, dressing for, 480
Rectum diseases of, electrothermy in, 437
Residents (E.), 1
Respiratory conditions, acute abdomen and, 349
Retroperitoneum, malignant fatty tumors of, 512
Rhythmic surgery, 371, 393
Ribbon-gut, in repair of hernia, 509

Sarcoma, neurogenic, 275
Scalp, dressing for, 128
Scars, carcinoma of, 304
Scrotum, thrombophlebitis of, 228
Sextus Empiricus (Bo.B.), 328

Shoulder joint complex
pathology, 201
therapy, 201
Skin
graft, in ambulatory patient, 67
tube pedicle, viability of, 92
progressive postoperative gangrene of, 87
Slough, following amputation for crushing leg injuries, 320
Sodium amytal anesthesia, effect on blood, 399
Spermatic cord, torsion, in cryptorchidism, 307
Spleen, hemangioma of, 519
Splenectomy, in Gaucher's disease, 77
Stomach, ulcer of, brain disease and, 474
Supply table, for operating room, 395
Surgery
of ambulatory patient, 57
Surgery, rhythmic, 371, 393
Syphilis, in pregnancy, 213
Systemic conditions, acute abdomen and, 354

Telangioma, of spleen, 519
Testes, undescended, torsion of cord in, 307
Thomas splint, rotary, for fractures of arm, 123
Thrombophlebitis, of penis and scrotum, 228
Thyroid disease, types of, 259
Thyroidectomy, anesthesia for, 22
Tissue section, rapid methods, 458
Tourniquet, local asphyxia and, 192
Trauma, of hand, relation to occupation, 51
Tube
double lumen, in intestinal obstruction, 412
pedicle skin graft, viability of, 92
Tuberculosis, pelvic, 216
Tumors
malignant fatty, of retroperitoneum, 512
of carotid body, 103

Ulcer
gastric, brain disease and, 474
peptic, perforation in, 427
effect on results, 419
Ulna, fractures of, dressing for, 480
Ulnar nerve, delayed neuritis of, surgical treatment, 501
Ureter, calculous obstruction, rupture of kidney and, 288
Urinary tract
antisepsis, benzochrome in, 449
malignancy of, treatment with supervoltage *x*-ray, 220
Uterus
prolapse of, new surgical procedure in, 42
retroversion, intestinal obstruction following Webster-Baldy operation in, 498

Vapor, superheated antiseptic, in treatment of infected wounds, 119
Venereal bubo, differential diagnosis, chancroid bacillary antigen in, 384
Vesico-intestinal fistula, 135

Webster-Baldy operation, intestinal obstruction following, 498
Wire gun, new, 526
Wounds
infected, treatment with superheated antiseptic vapor, 119
penetrating, of heart, 108

X-ray
of breast, soft tissue technique, 310
supervoltage, in treatment of urinary tract malignancy, 220